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AND PATTERN MAKER.

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"Wasters."*

By Mr. F. H. Hurren.

The question of scrap castings is a vital one in every foundry. All foundries under-estimate the percentage of scrap made, and in most shops there is a desire to hide a waster as soon as it is discovered. In a way, this is a natural desire, but it does not tend to the reduction or elimination of scrap; no waster should be broken up until an "inquest" has been held on it by all the men concerned in its production. More knowledge can be gained from the examination of one failure than from a hundred successes. Wasters can be a real source of information, and from a careful study of the same, we can get very definite knowledge of cause and effect. At times we certainly do get wasters for which no reason is apparent. There must be, of course, a reason for every waster, although such reason cannot always be definitely located.

The principal reasons for which castings are scrapped may be classed as:—Short pours, run-outs, mis-runs, cold shuts, cold shots, crushes, scabs, blows, cross-joints, cores lifting, contraction cracks, cores broken, strain or swell, presence of dirt or slag, sponginess, porosity, and hard spots. In addition there are many other causes less common, such as segregation of alloy, and oxidised metal.

This may sound a formidable list, but it really only touches the fringe of the subject.

Taking these troubles in the order given, short pours and run-outs are very obvious defects, and the cause in most instances is carelessness. The remedy lies in the hands of the moulder. When a mould bursts out at the joint, it is the usual practice for everyone to get excited, and throw sand at the stream of metal. This results in splashing metal all over the shop, and burning the clothes of the unfortunate workers in the immediate neighbourhood. A piece of clay on a bod-stick (such as is used for the cupola) quietly applied at the joint in the moulding box, will usually effect a stoppage. If the run-out is too big for this, it is better to leave it alone and not waste any more metal. In connection with run-outs, a word or two on weighting moulds may be advisable. As is well known, molten metal has a lifting effect; and unless this is counteracted, the top part of the box is liable to float, and a run-out result. The lifting pressure depends on the area of the surface of molten metal in contact with the top box, and also the depth of the gate. Several fundamental facts must be borne in mind. Firstly, a column of molten iron 1 in. square and 4 in. deep exerts a pressure of 1 lb. on the bottom surface. In other words, molten iron exerts a pressure of 1 lb. per square inch of mould surface for every 4 in. of height, whatever the cross-area of the column. Suppose now, we were casting a plain plate 12 in. by 1 in., this being moulded in the bottom part, and covered by a top box 4 in. deep carrying a 2-in. runner bush. The total depth of the gate is thus 6 in. The area of molten metal in contact with the top part is 12 by 12 equals 144 square inches. The pressure exerted by the metal in the 6-in. down-gate is 1½ lbs. per sq. in. (that is, 1 lb. for every 4 in.) Hence the total lifting pressure of the molten metal would be 144 by 1½ equals 216 lbs.

The question is still further complicated by the lifting pressure due to the presence of cores. Iron weighs approximately four times its own volume of sand. Suppose, therefore, a core weighs 20 lbs., it will displace 80 lbs. of iron. The difference between these two weights has to be added to the lifting pressure due to the cause previously mentioned. The whole question of fluid pressure is a very difficult one, and it is far better to err on the side of over-weighting than to under-weight a mould and have a run-out.

Mis-runs and cold shuts are closely allied, although varying in appearance. Where a casting shows a distinct section which has not run up, the section having very rounded edges, it is called a mis-run. A casting which has a section showing a line where two streams of metal have met but failed to unite is known as cold shut, although, technically speaking, it is a mis-run. Cold shuts and mis-runs may be caused by dull metal, too small a pouring gate, or bad pouring. Good castings are never made from dull metal, and no man is justified in casting his work with metal of this class. Men are too apt to take a shank of metal just because it happens to be their turn, and cast a scrap, rather than wait for the next tap out to get hotter metal.

Bad pouring is quite a common fault. Some men pour metal in the same manner they would pour beer from a bottle, just dribble it in, fearing to create a froth. Others are just the reverse, and slop metal indiscriminately over the runner bush, the floor, and the feet of anyone standing around. Castings should be poured with decision, and an endeavour always to keep the bush just full. In casting aluminium, large runners are advocated, but these can be so large and the casting poured so rapidly, that a mis-run results. This may sound paradoxical, but the reasons briefly are these:—Aluminium is rather a sluggish metal to run, and

* Presidential Address before the Coventry Branch of the Institution of British Foundrymen, Oct. 6, 1920.

very quickly becomes pasty. Before a mould can be completely filled, every particle of air must be displaced. If the metal is poured very rapidly and immediately comes up the risers, an air-lock may take place in the mould. By the time this air has escaped through the sand, the surrounding edges of aluminium have set, and a mis-run is the result. This is a matter which is worthy of attention.

Cold shots, as distinct from cold shuts, are evidenced by the presence of small round pellets embedded in a mass of metal, but easily detachable. Cold shots are sometimes caused by the pourer dropping into the gate a few spots of metal from the lip of the shank as he starts to pour. These drops break up into small pellets, and the following metal may not completely dissolve them. Another reason may be when a casting is rather deep, and the metal has a long drop in the gate, the first metal becoming scattered. On the other hand, cold shots may be caused by a miniature blow. The hot metal in the mould encounters a slightly damp spot of sand. Steam is generated and bubbles through the molten metal, causing "shots" to form. As a rule, cold shots mostly show up during machining operations.

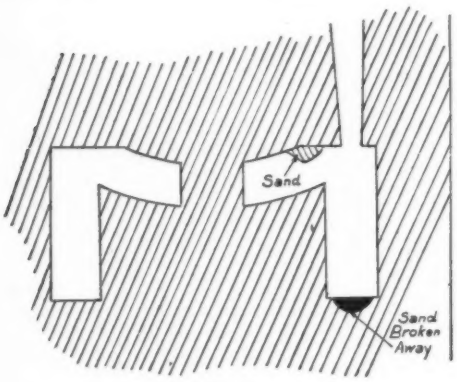

FIG. 1.

Crushes are a very vexing form of scrap, but one that could easily be avoided by the exercise of care on the part of the moulder. When a box part is tried-on, an examination of the mould after the part has been removed should show any evidence of crush, and scrap from this cause can only be due to negligence.

Scabbing is another very common trouble. Presumably, everyone is familiar with this type of scrap. It is caused by a piece of the mould or core becoming detached, leaving an unsightly mark or patch on the casting. In addition, the detached sand is floated away, and either comes to anchor as a solid lump in some other part of the casting, as indicated in Fig. 1, or is broken into small particles which show up as dirt on machining. Scabs may be caused by hard ramming, damp spots, or insufficient venting. In either case the effect is the same. As soon as metal comes in contact with the mould face, gases are generated. These gases must escape freely through the sand. If they are unable so to do, owing to hard ramming or insufficient venting, they take the line of least resistance, pass through the metal, which is more or less agitated. A slight agitation causes a piece of sand to become detached from the mould, and a scab results. In moulds made from sand which has been unevenly wetted, as soon as the hot metal comes in contact with a very damp patch, an excessive volume of steam is generated, with the result that portions of sand from the mould are broken away. A violent agitation of the metal causes a blow.

Blowing is a prolific scrap producer, often attended by danger to those working in the shop. As just stated, when a mould is poured, a large volume of gas is generated. If from any cause it is unable to pass freely through the sand, it naturally passes through the metal. Sometimes it does this with such force that large bodies of molten metal are violently ejected. Blowing is really a more pronounced form of scabbing, and results from the same causes. One occasionally sees moulds and cores with plenty of vents internally, but only a very small exit. There appears to be no reason for putting in a core, four or five $\frac{1}{8}$ in. vents, all leading into a $\frac{1}{4}$ in. exit. Congestion of gases is bound to occur, and at the most vital time. Experience shows that core-makers are inclined to pay rather less attention to venting than moulders. Blowholes may be due to gases in the metal, particularly with steel castings. As a general rule, blowholes due to the mould are brightly coloured, whilst those due to gases in the metal are clean and colourless. Blowing may be caused by metal getting in the vents, thus preventing a free escape of gas. This is due in many instances to cores fitting rather loosely in the prints, and the gap between not being filled with sand, oil and blacking, or some other form of stopping. From time immemorial, moulders have been in the habit of rubbing cores whether they wanted it or not. If a vent happens to be quite near the surface, this rubbing may cause the skin of sand over the vent to become so thin that the force of metal during casting will burst it. By metal entering the vent a blow almost inevitably results. On the other hand, it may be necessary to gum cores together, and if this is not carefully done metal will penetrate between the two and enter the vents. A scrap caused by blowing is particularly deserving of close investigation, or the complaint may become chronic.

Cross-jointed or over-shot castings are usually caused by ill-fitting box pins. This is more often a point for the foreman in charge to put right; although there have been cases of men working with loose-pin boxes, use a pair of $\frac{3}{4}$-in. pins instead of the $\frac{7}{8}$-in. pins supplied them, because the former were an easier fit. Where loose-pin boxes have to be weighted or cottered, this should be done before the loose pins are removed, otherwise a cross-jointed casting may result. Another form of scrap from this cause occurs in machine moulding, where the operator has put his top part on the wrong way round, with sometimes very curious results.

Cores which are large in area are prone to lift, especially where the prints are small, resulting in a casting very thick on the bottom side, and very thin, or cut through on the top. Often there is no other remedy for this than the use of chaplets, and these need to be very carefully placed. In motor-cylinder work particularly, it is necessary to tie cores down with copper or iron wire. The moulders requires to be very careful in doing this to ensure that metal shall not reach the wires. It only needs a few drops of metal to fuse copper

wire, and the core becomes free, with fatal results to the casting.

Contraction cracks do not occur so frequently in cast iron as in malleable and aluminium castings. With the latter it is often necessary, as soon as the metal has set, to ease the tension by digging out the cores and removing the grids. This job requires nice judgment, as aluminium passes through a stage when it is very pasty and easily broken. If the easing operation is started too soon, the casting may be damaged; and if left too long, it may crack before the core can be got out. Particular attention should be given to the method of gating, as that part of the casting nearest the gate is

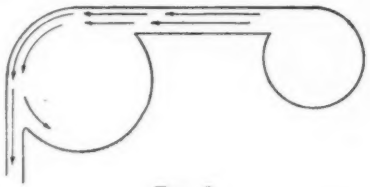

FIG. 2.

usually the last to solidify. It may be that the still liquid metal is pulling at that part already set, causing a crack to develop. An alteration in the method of running will often effect a cure. There is no royal road to successfully overcoming contraction cracks; each job has to be taken on its merits, and various methods tried until success is attained.

Broken cores are not so very common, and more often than not are cracked by the moulder when placing or tying in position. The tying down of cores is an operation which needs care and judgment, as an extra turn or so to the anchor or holding-down nut may either break the core or pull it through the mould. When either of these happens,

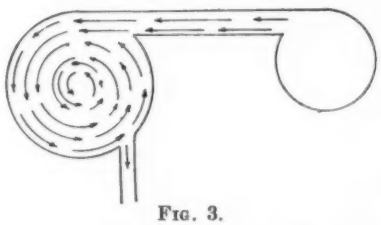

FIG. 3.

the resultant casting is a waster. There have been instances of cores with very frail projections being made without strengthening wires, but these cases have been few and far between. Usually the cores are cracked in handling, and the force of metal causes a lump to become detached.

Strain or swell is caused by soft ramming, and although not always resulting in scrap, produces a very unsightly casting. This is a matter where the remedy is simple and quite obvious.

The presence of dirt or slag in castings is a very common form of scrap, but at the same time it is often a matter of considerable difficulty to overcome this trouble. Moulders generally cut their down-gates with a tube, which always leaves ragged edges of sand. If they omit to run their cleaner or finger round, to wipe off these ragged edges, the first entry of metal washes away this loose sand, and carries it into the mould. At times, too, men will rather stand five minutes at the furnace for a shank of metal than five seconds to have the metal skimmed. Metal and slag are poured into the mould indiscriminately, and then wonder is expressed when the casting is rejected.

Dirty castings are produced, of course, when blowing or scabbing has taken place, but at present attention is only being given to primary causes. Doubtless much of the scrap from the presence of dirt is due to size and shape of runner. A point which requires considerable emphasis is that the area of the pouring gate should be greater than the area of the gate at its junction with the casting. Suppose a casting is run by a double spray gate, each being 1 in. long × $\frac{1}{4}$ in. thick, at the point of contact with the casting. The combined inlet area is $\frac{1}{4}$ sq. in. A down-tube $\frac{7}{8}$ in. diameter has an area of less than $\frac{3}{4}$ sq. in. Even if the down-gate is kept full during pouring, the in-gate is not quite full; and there is a tendency for sand to be drawn from it, and carried into the mould.

For most malleable castings, and some of cast iron, a "spinner" is used. There is a wrong way as well as a right way of cutting a spinner. In the incorrect spinner, shown in Fig. 2, the first metal carrying any dirt passes directly into the casting. In the correct form, Fig. 3, the metal

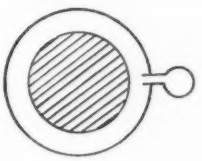

FIG. 4.

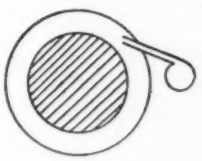

FIG. 5.

passes right round the spinner, having a rotary motion imparted to it, which retains the dirt in the centre, the casting being fed from the outside edge.

Sometimes a runner is so placed that the incoming stream of metal plays directly on to a core, or a portion of the mould. The sand on which the metal impinges is cut away, and a dirty casting results. This can usually be remedied by making the runner tangential, as shown in Figs. 4—5. The size and shape of runners is a subject worthy of very close attention, and one that will well repay the time spent on its study; always bearing in mind that no matter how well a runner has been placed, unless every portion of it, from the runner-bush to the casting, can be kept filled with metal, there is a risk of dirty castings. It is obvious that this cannot be accomplished unless the total area of the in-gates is less than the area of the pouring gate.

The question of sponginess may be one for the foreman to take in hand. Spongy places usually occur where thick and thin sections join. The remedies worth trying are alterations in position or size of runner, variations in the temperature at which the metal is cast, and, finally, the use of risers or chills. Porosity is a similar trouble, and the cure is the same, with the additional probability that a change in composition of the metal may be necessary.

Hard spots are a very aggravating source of worry, and make the foundryman's life a burden

to him when he visits the machine shop. Hard spots are often caused by the sand in the mould being unevenly damped down, and sometimes through irregular venting. Hard spots in annealed malleable castings frequently occur where the runner or riser has been, and are caused during bobbing. If the fettler leans heavily on his emery wheel the casting becomes very hot, and the patch which has been bobbed reverts very nearly to its hard state previous to annealing. This is usually evidenced by a blue appearance on the bobbed portion. More care and less strength in the arm will practically eliminate this trouble.

Another source of scrap, namely, segregation, occurs more particularly with aluminium alloys, and to a less extent with gun-metals. Aluminium castings which looked quite satisfactory on the top side, as cast, may have a portion of the bottom side a mass of needle-like crystals. What has happened is the alloy has been melted satisfactorily, but not stirred sufficiently, and a proportion of the spelter has settled in the bottom of the crucible. Analysis has proved this to be so; in one particular instance the percentage of zinc being 12 per cent. in the top part and 27 per cent. in the affected portion of the bottom part. This is mentioned to emphasise the necessity for thorough stirring before casting aluminium or gun-metal alloys.

The foregoing are some of the many causes of wasters, and every foundry worker is urged to take a more keen personal interest in his work, and, where scrap results, use his reasoning powers and endeavour to find a remedy. Unfortunately, some men never consider it worth while to make suggestions, putting all the responsibility on the man in charge. This is a short-sighted policy, and does not tend to improve the man's own knowledge or position in life. There is surely no harm in making suggestions, as no one section can claim a monopoly in brains.

Discussion.

Mr. Prickett asked the lecturer to explain the cause of the scab sometimes formed when the metal was run directly on to the core, and remarked that some castings, *e.g.*, large bedplates, necessitated this method of running, and were successful.

Mr. Roberts inquired the reason that malleable castings sometimes fractured during the annealing.

Mr. Oubridge remarked that, instead of using box weights, he held the boxes down by means of clips, with wing-nuts and screws. The speaker had made no reference to analysis. A few years back he had used tablets to remove sulphur, and had been so successful that he had continued the practice until he found his castings becoming too soft, and had had to raise the sulphur content again. Cracking was sometimes due to bad design in cases where thick sections joined on to thin walls; if harder metal were used to overcome this chills were the result, and if soft metal then porosity was apt to appear.

Mr. Judd inquired whether the speaker found porosity a cause of many wasters, and how he overcame this difficulty in the case of two barrels at the connection of the water jacket of water-cooled cylinders.

Mr. Carey Hill observed that his experience of wasters was very similar to that of those who had already spoken. In the case of aluminium the results were accentuated, especially in regard to porosity. As to segregation, the metal had to be stirred, not only when in the furnace but also in the pouring ladle. He had had a case in which large castings were poured first, taking about 120 lbs. from the ladle, and the remaining 20 lbs. were used for small castings, and it was found that the latter varied much in weight. Analysis solved the trouble by showing 10 per cent. zinc in the large and anything up to 34 per cent. in the smaller ones. To prevent porosity judicious placing of feeders was necessary. Uneven pouring was sometimes to blame. He considered it a great mistake to use a large number of chills before trying what could be done by means of judicious placing of feeders. When he had a large order to carry out he tried two or three experimental castings with as few chills as possible; these castings were then thoroughly inspected for defects, dressed and cut up and examined for cracks, porosity, etc.; the job was then laid out so as to obviate these defects.

Mr. Whitworth asked if there was not some danger of a reflex action, or backwash, when the metal had to run some distance into the casting, thus causing a mis-run. In the case of the extreme end of the levers, he had overcome this by the use of a blind riser. In the case of thin castings, when the metal was flushed in, was it not desirable to have stronger sand at the bottom gate in order to resist the rush of the metal? He considered that it was necessary to have, as it were, countersunk top gates in order to overcome the strain due to high pressure. He would like to know the effect on the casting when the pressure caused by a great weight of metal was resisted by the boxes being locked together.

Mr. Williams remarked that the weight of the metal was not the only factor involved in considering the pressure, for the velocity of the liquid metal also exerted considerable influence. In casting piston rings he was in the habit of using as many as twelve boxes locked together, and in this case the bottom rings suffered a much greater shock, and, being very delicate, required stronger sand in the bottom boxes. He found that with large castings it was necessary to use box weights in addition to locking the boxes, otherwise the sand in the top box was liable to be forced upwards on account of the pressure.

A further cause of bad castings was to be found in small particles of metal being left in the moulding sand having got through the riddle, and these caused hard spots in the casting.

He quite agreed with the speaker's remarks about tangential runners. If the runner was placed perpendicular to the core the latter was partly washed away, and this trouble could not be overcome by the use of stronger sand on account of the difficulty of proper venting. The size of runners was an important consideration. He always had them made on plates, and the dimensions were recorded on the drawings.

Mr. Hurren, replying, pointed out to Mr. Prickett that the causes of scab were given as hard ramming or insufficient venting. Where it was impossible to run except directly on to a part of the core or mould, special precautions had to be taken in the way of sprigging and great care in venting.

The reason malleable castings sometimes fractured during annealing is that the metal in the hard state is highly crystalline, and where a

sharp angle occurs, or a thick and thin section join, there is always a line of weakness through the crystal boundaries. In annealing the heat causes unequal expansion and the casting cracks.

He would point out to Mr. Oubridge that it was not always possible to lock box parts together, but this was good practice where it could be carried out. He had made no reference to analysis, as he had confined his remarks entirely to faults developed in production. He thought too much had been made about high sulphur. Dr. Stead, in his Presidential Address before the Iron and Steel Institute, stated that "0.1 to 0.15 per cent. sulphur was advisable in cylinder castings." He (Mr. Hurren) did not worry about sulphur up to 0.16 per cent.

In regard to Mr. Judd's query, he had found that porosity in cylinders was more pronounced with low phosphorus irons, and if the phosphorus was raised to 1.1 or 1.3 per cent. scrap due to porosity was very small. He had made cylinder castings thirteen years ago for motor-car engines with phosphorus as high as 1.45 per cent., and many of these were still doing good work to-day.

He was glad to know from Mr. Carey Hill's remarks that he was not alone in experiencing trouble due to segregation of alloy. He quite agreed with Mr. Hill in the advisability of using as few chills as possible on aluminium castings, and always considered chills a last hope.

Mr. Hurren, replying to Mr. Whitworth, said there was a possibility that backwash was the cause of the streaky or cold-shut appearance of some thin castings. The value of a blind riser lay in the fact that it acted as an outlet or pocket for the air in the mould, and aided its escape at casting time, preventing an airlock, which was the main cause of mis-runs. At times stronger sand at the runner was most desirable, otherwise scabbing was likely to occur. With regard to Mr. Whitworth's last question, if the locking was unable to resist the pressure of metal a burst-out would result.

He agreed with Mr. Williams that there were many other factors to be considered regarding lifting pressure, and would remind him he had advocated over-weighting rather than run any risk. The lifting up of the sand in the top box was liable to occur if weights were not used, even if the box-parts were cottered together. This was more likely to occur where the top box was devoid of bars. Harder peg-ramming round the sides of the box was necessary, and even then it was desirable to place weights across the box. The danger could be largely overcome by having the sides of the moulding box taper. At his own works, where it was possible, most of the moulding boxes were made to taper 45 deg., and he had found no liability to lift, even where cross bars were absent. He agreed with Mr. Williams as to particles of metal in the facing sand causing hard spots. Moulders usually discovered any sharp pieces of metal when they were rubbing the sand through the sieve, but rounded pieces were not noticed, and, if in contact with the mould face, acted as chills. He was glad to know Mr. Williams was in accord with him respecting tangential runners, as most of Mr. Williams' work demanded this type of runner.

In conclusion, he wished to urge very strongly that, where a waster was produced, it should be examined with care and intelligence in order that the same faults be not repeated.

Accidents in American Steelworks

Bulletin No. 256 (Revision of Bulletin 216) recently issued by the United States Bureau of Labour, gives figures which, though somewhat belated, show the progress made in accident prevention in metallurgical and engineering plants. The subjoined particulars relate to accidents in steelworks for the years 1905 and 1913 :—

Table I. gives, under the various headings, the principal causes of accidents experienced in a large representative steelworks during the period under review. It covers 10,390 cases of accident, and gives the percentage of frequency rate and severity rate per 1,000 300-day workers.

TABLE I.—*Comparing Accident Causes in a Steelworks during the year* 1905 *with* 1913.

Accident causes.	Frequency rates (cases per 1,000 300-day workers)		Severity rates (days lost per 300-day worker)	
	1905.	1913.	1905.	1913.
Falling and flying objects	92.7	25.3	6.9	3.5
Falls of worker	31.2	9.0	1.4	2.7
Hot metal	26.6	11.9	1.3	3.9
Cranes and hoists ..	19.0	12.2	2.8	3.3
Handling material and work	26.2	10.2	0.2	0.1
Using tools	17.2	10.8	0.2	0.1
Operating machines ..	15.9	3.6	0.5	0.1
Locomotives, cars, etc.	12.5	5.0	2.8	0.2
Electricity	4.2	0.7	0.1	*
Belts, shafts and gears..	1.6	0.8	1.4	*
Unclassified	52.9	25.0	7.9	1.6
Total	300.0	114.5	25.5	15.5

* Less than 0.005.

Referring to the proportion of day and night accidents the bulletin considers that the constant excess of night accident rates over day accident rates in all available examples, indicates that such result is due to the operation of definite causes. Two such causes suggest themselves as of importance : (1) That the artificial light of the night is not equal to natural daylight, and (2) that the physical condition of the night-worker is not so good as that of the man on daywork, due to the fact that it is quite impossible that conditions of restful sleep can be furnished in the day comparable with those of the night.

From a chart showing the marked excess of night accidents in various departments of a steelworks we give the following details which relate to combined figures compiled for 1905 to 1913. The day is reckoned from 6 a.m. to 6 p.m. :—

TABLE II.—*Showing Excess of Night Accidents over Day Accidents for years* 1905 *to* 1913.

Department	Accidents per 1,000 300-day workers during nine years ended 1913.		Total days lost per 300-day workers during nine years ended 1913.		Total number of 300-day workers who received employment during nine years ended 1913.	
	Night	Day.	Night.	Day.	Night.	Day.
Blast furnaces	229	204	55.6	31.8	2,879	6,413
Steelworks ..	224	218	38.0	25.1	3,638	5,045
Rolling mills ..	160	150	17.2	14.7	6,516	10,789
Mechanical ..	389	122	36.8	15.9	556	7,767
Yards	399	139	74.7	9.2	874	5,083
Other departs.	227	69	32.9	12.1	1,209	9,880
Entire plant ..	214	142	35.2	18.1	15,672	44,977

The Influence of Nickel and Cobalt Additions on the Physical and Chemical Properties of Cast-Iron.

By Prof. O. Bauer and Dr. E. Piwowarsky.*

Considering the extensive use of alloy steels and their extraordinary rapid development within the last few years, one would have expected that experiments would have been made long ago to find out whether certain additions to cast iron improved its quality in the same way as they did in the case of alloy steels. Although the carrying out of such experiments was so obvious, very little published information is to be found relating to this subject.

The eventual usefulness of nickel additions in this respect has so far evidently not been investigated sytematically, although considering the important part this metal played in the early history of the making of special steel, one would have naturally assumed that it would have been the very first material to experiment with in trying to improve cast iron. Probably the assumption that, owing to the higher melting point of nickel compared with that of cast iron, the suitability of the former to produce an alloy was questionable. The following experiments to test the suitability or otherwise of nickel additions to cast iron may, therefore, be of interest.

The material used in these experiments was a pure Swedish charcoal pig with a total carbon content of 3.90 per cent., graphite 2.80 per cent., phosphorus 0.048 per cent., manganese 0.18 per cent., and silicon 0.69 per cent. The nickel used was electrolytic nickel. A few initial experiments were made in a Friedrich furnace with small charges of 100 kg. each with 1, 2 and 3 gr. of nickel added respectively. These were intended for plotting solidification curves with the help of a Richards chronograph. These already proved the fact that nickel at a temperature of only 50 deg. in excess of the melting point of cast iron easily formed an alloy with it. It was therefore decided at once to make meltings of heavier charges.

A charge of 2,250 grs. of pig-iron with ample addition of graphite was melted in crucibles in a Helberger furnace, the temperature of the molten metal

Table I.—*Melting Experiments with Cast-iron with Nickel and Cobalt Additions.*

Test-piece No.	Per cent. Ni	Per cent. Co	Total carbon per cent.	Graphite per cent.	Graphite in per cent. of total carbon	Bending strength in kg. per sq. mm.	Deflection in mm.	Tensile stren'th in kg./mm²	Compression test in kg./mm²	Brinell hardness	Specific impact strength in kg. per sq. cm.	Solubility in acid. Loss of weight of a 10 mm. cube in per cent.
1 a ..	0,0	0,0	3,91	2.80	73,0	22,3	7,6	10,5 10,0	58,1	143	0,4 ; 0,38 ; 0,57	18,7
1 b ..	0,0	0,0	3,89	2,96	73,8	26,3	6,2	9,6 10,2	57,3	147	0,37 ; 0,47 ; 0,52	17,9
Average	0,0	0,0	3,90	2,83	73,4	24,3	6,9	10,1	57,7	145	0,45	18,3
2 a ..	0,85	0,0	3,88	2,87	74,0	33,0	7,6	14,1 13,5	71,5	168	0,46 0,53	14,3
2 b ..	0,89	0,0	3,90	2,83	74,2	29,6	6,0	10,9 11,2	78,0	174	0,37 0,37	14,9
Average	0,87	0,0	3,89	2,85	74,1	31,3	6,8	12,5	74,75	171	0,43	14,6
3 a ..	1,24	0,0	3,79	2,93	77,3	28,6	5,1	13,6 12,9	58,2	171	0,40 0,40	14,7
3 b ..	1,26	0,0	3,73	2,89	76,9	19,4 flaw in casting	7,3	13,2 13,9	72,0	179	0,40 0,40	14,9
Average	1,25	0,0	3,76	2,91	77,1	—	—	13,4	65,1	175	0,40	14,8
4 a ..	1,92	0,0	3,71	3,14	84,0	29,4	5,9	10,15 10,0	66,0	146	0,52 0,40	15,1
4 b ..	1,98	0,0	3,69	3,10	84,0	27,3	5,9	10,15 11,10	61,0	152	0,59 0,43	15,9
Average	1,95	0,0	3,70	3,12	84,0	28,3	5,9	11,10	63,5	149	0,48	15,5
5 a ..	0,0	0,92	3,91	2,85	74,2	23,80	5,9	10,9 9,5	47,0	147	0,46 0,46	16,2
5 b ..	0,0	0,90	3,87	2,92	74,6	24,70	6,3	6,7 6,7	56,5	149	0,40 0,46	15,8
Average	0,0	0,91	3,89	2,88	74,4	24,20	6,1	9,0	51,7	148	0,44	16,0
6 a ..	0,0	1,88	3,82	2,54	66,4	19,90	5,1	9,4 10,1	52,5	149	0,44 0,38	13,8
6 b ..	0,0	1,92	3,88	2,58	66,6	18,80	6,1	9,7 8,9	54,5	155	0,41 0,41	14,0
Average	0,0	1,90	3,85	2,56	66,5	19,30	5,6	9,3	53,5	152	0,41	13,9

* Communication from the Ironmasters' Institute of the Technical High School in Breslau.

was raised to exactly 100 deg. above the fusion point of cast iron, and the nickel was added in pre-weighed quantities in small pieces. The melt was then well stirred with a carbon rod, and two ingots were cast vertically in well-dried sand moulds, the test pieces being 20 mm. in diameter and 650 mm. long. Four meltings were thus made, one without and the other three with pre-determined nickel additions.

It was settled at the outset that the nickel additions should not exceed 2 to 3 per cent., as meltings with a higher percentage were bound to be difficult to carry it out in practice, besides which the material produced would also have been too costly. The test pieces thus made, after being allowed to cool and cleaned, were broken by bending with the skin on, in a machine for testing cast iron on supports 600 mm. apart. All bars broke in the centre. From each broken half samples were taken by drilling for chemical analysis, a further piece 15 mm. long was sawn off for metallographic examination, and the rest used for preparing pieces for impact tests and two cubes for compression tests. All test specimens were taken from the middle, the pieces for the impact tests being 10 x 10 x 100 mm. without notches and the cubes were 15 x 15 x 15 mm. The impact tests were made in a 10-m. kg. Charpy pendulum machine and the compression tests in a 50-ton Martens machine.

The broken pieces resulting from the impact tests were used for testing their solubility in acid. Pieces 10 x 10 x 15 mm. were placed in a large cup and kept for 24 hours in one-per-cent. sulphuric acid, after the lapse of which period the metal loss was ascertained. From the other half of each standard bending-test piece a small tensile-test bar was made of the dimensions

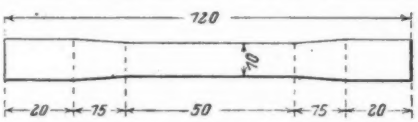

FIG. 1.

shown in Fig. 1. Brinell hardness tests were made on the polished surfaces after they had been examined under the microscope. The diameter of the ball was 10 mm., the pressure 1,500 kg. The hardness number was computed from the formula:—

$$H\ (\text{hardness}) = \frac{P}{\text{area}} = \frac{2P}{\pi D\left(D - \sqrt{D_2 - d^2}\right)}$$

wherein D = diameter of ball and d = the diameter of the impression.

The results of these tests are shown in Table I. (1a to 4b). The best results were those obtained with about 1 per cent. of nickel. The increase in resistance to bending was about 30 per cent., compared with the original cast iron, the deflection being nearly the same. (1) The compressive strength was also increased by 30 per cent., the tensile strength by 25 per cent., while the hardness was only increased by 18 per cent. As was to be expected, the solubility in acid was less, but not quite to the extent one would have thought. An addition exceeding 1.5 per cent. of nickel proved of no advantage, as the influence of the nickel on the segregation of the graphite outweighed the refining effect on the ferrite grains.

Metallographically, all specimens showed the normal structure of a good grey cast iron, namely, very evenly distributed graphite plates in a matrix of ferrite and pearlite in neatly formed lamellæ.

For making special castings for machine parts, cog wheels, etc., an addition of nickel up to 1.2 per cent. may therefore be certainly recommended; the slight increase by about 5 deg. of the fusion point could hardly be considered a disadvantage in practice.

It was of interest to know whether cobalt had the same influence on cast iron as it had on steel, especially as it closely resembles nickel in many respects. In order to settle this point, two trial meltings were made with the same Swedish charcoal pig-iron in a Helberger furnace with an addition of 1 per cent. and 2 per cent. of cobalt in the finished product respectively, and dealt with in exactly the same way as had been the nickel specimens. The metallic cobalt used in the experiments was made from a pure cobalt oxide by reduction with charcoal in the Friedrich furnace. The examination and testing of the test pieces was done in every way similar to that used in the nickel-specimens. The results are shown in Table I. (Tests 5a to 6b). As will be seen by these, the influence of cobalt was remarkably the exact reverse of that of nickel. The resistance to bending was greatly reduced, the tensile and compressive strengthe also showed a gradual falling off; the hardness test, however, was somewhat better. These results harmonise with the chemical analysis. Cobalt hinders the segregation of graphite and favours the formation of carbide in conformity with its behaviour when used as an alloying metal for special steels and high-speed steels. The solubility in acid permanently falls off; there is no turning point to be expected, as observed in the case of nickel Accordingly the use of cobalt for improving cast iron is out of the question.

The magnitude of the specific impact test values was very small. It is, however, peculiar that no definite influence on these values could be established. This agrees entirely with the experience hitherto gained. Bach was equally unsuccessful in obtaining more favourable results with special cast iron than with ordinary grey cast iron.

STEEL FOUNDRIES CO-OPERATE IN RESEARCH.—Mr. R. A. Bull, Pittsburgh, has been appointed consulting metallurgist for a number of prominent steel foundries grouped for the purpose of developing and perfecting higher standards in the production of steel castings. Mr. Bull will devote his entire time to preliminary research work immediately and has resigned his position as vice-president of the Duquesne Steel Foundry Company. The members of the group include:—Electric Steel Company, Chicago; Fort Pitt Steel Castings Company, McKeesport, Pa.; Isaac G. Johnson Company, Spuyten Duyvel, N.Y.; Lebanon Steel Foundry Company, Labanon, Pa.; Michigan Steel Castings Company, Detroit; Sivyer Steel Castings Company, Milwaukee. Mr. Bull is widely known in the steel castings industry, and since 1911 has been a director of the American Foundrymen's Association, and during 1916 and 1917 served two terms as its president.

MEDAL OFFERED.—PLAN TO STIMULATE IMPROVEMENTS IN THE MALLEABLE CASTINGS INDUSTRY.—To stimulate the interest of the industry in the making of improvements in the chemical, metallurgical and practical processes involved in the manufacture of malleable castings, the American Malleable Castings Association has decided to offer a medal from time to time as an award when improvements are brought out. This step was taken at a meeting of the Western Section of the Association held in Chicago, September 15. A committee of three was appointed by the chairman of the Research Committee of the Association to draft regulations for carrying out this plan. At the same meeting definite action was taken towards the appointment of inspectors to visit plants of members and examine their product with a view to generally improving the quality of malleable castings. The Association's consulting engineer was authorised to employ at the start from four to six young men who will be trained in malleable iron practice, with a view to making them competent inspectors. The men selected will be given about six weeks' instruction in the Association's laboratories, and later two weeks' instruction in plant practice in the plant of some member.

Runners and Risers.

By Joseph Horner.

Many a good mould has produced unsatisfactory results, even an absolute waster casting through lack of the exercise of care and judgment in the method of pouring. Different kinds of castings require each a suitable treatment, quite apart from the preparation of the moulds.

The fundamental fact is, that molten iron is a very heavy liquid, about seven and a half times heavier than water, and that the laws which govern the behaviour and the pressure of liquids operate in the case of molten metal. Although there are right and wrong ways of pouring all moulds, there is no hard and fast rule. Only broad principles can be stated, and these must be varied in their applications. Metal is introduced into the mould in diverse ways, from different heights, through ingates and runners of varied shapes and sizes. In many cases some portion of the molten metal, is permitted to go through the mould and flow off. The flow-off gates are often as important as the runners.

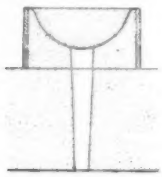

Fig. 1.

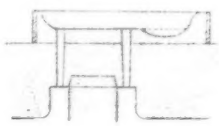

Fig. 2.

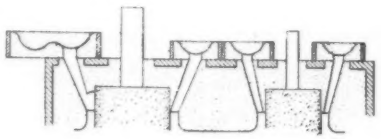

Fig. 3.

The primary questions which a moulder considers are first, where, and how to bring the metal into a mould, and, second, what area, and dispositions to provide for the runners and ingates. Just where to bring in the metal has to be decided by several conditions. Moulds are poured on top, or bottom, or from both locations, on one side, or end, or on opposite sides or ends. Moulds are laid horizontally, at an angle, or vertically, and are poured through one or several ingates. Special provisions are made in the form of flow-off gates to relieve strains, and to get rid of sullage. Skimming chambers, and head metal are often resorted to to fulfil the latter purpose. We may consider these separately.

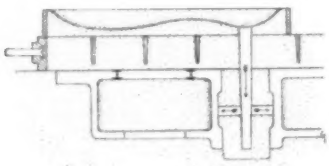

Fig. 4.

By far the largest number of moulds are poured horizontally, that is the longest axis of the mould occupies the horizontal position. In these, the most important distinction is, so far as the present subject is concerned, whether they are massive, or light; large, or small, the presence or absence of cores, of delicate, flimsy sections of sand, and the locations of portions that have to be tooled and polished

Unless good reasons exist for a contrary practice, moulds are poured from the top, the metal falling directly into the bottom of the mould. This is generally suitable for castings of moderate and small dimensions, those of a massive character, and those which have a good body of metal in a position to receive a runner, as in the bosses of wheels, rollers, and stout flanges and webs. In these the runner and ingate are one, and the pouring basin in the smaller moulds is merely a concave cup, Fig. 1. The metal falls direct into the mould, and the runner is usually of cylindrical form, with a slight taper.

Vital details that control the location of pouring, are, the presence of cores of flimsy sections of sand, and the tooling of portions. It is undesirable to bring an ingate directly against either of these surfaces. If an alternative location offers, as is generally the case, it must be adopted. Fig. 2 shows metal being brought into a boss through two runners, missing the core. Fig. 3 shows pairs of runners coming into the head metal of a double cylinder, and the metal will fall from top to bottom of the mould beside the cores. In Fig. 4 the metal comes in through a central core, being diverted horizontally to right and left, to fall through half the depth of the mould. The runner and ingates are rammed in the core in a half-box, a method that has been adopted in casting large numbers of crane beds. Fig. 5 is an example of a horizontal ingate being located in the lower half of an anvil block mould. The method is preferable to that of letting the large volume of metal fall from the top to the bottom, a matter of about 4 ft. In the frame, Fig. 6, horizontal ingates come in line with main webs of the casting—pouring taking place in two similar webs on opposite sides. Somewhat similar is Fig. 7, where horizontal ingates are brought into the exact space lying between the outer mould and the central core, the print of which is seen carried out to the right, flanked by the square runner and ingate.

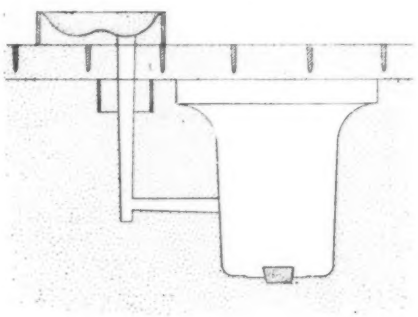

Fig. 5.

The case of pipes and columns, moulded horizontally, admit of three methods of treatment. Pipes and columns of fair substance can be poured from the top direct, the metal running down the sides of the core, and distributing to right and left. It is well to put risers on the flanges. An alternative is to bring the metal in at one, or on opposite sides, where it

will beat against the core and run to right and left. In such castings a wide, thin ingate should be used, or a spray. Generally, it is better in the longer castings to pour from the end, or both ends in those of great length In these, the metal is liable to become dirty and chilled by prolonged contact with mould and core, which is avoided, or lessened if it is directed from both ends at once Scabbing is more liable to occur in consequence of the prolonged beating of metal against cores or mould.

The objection of bringing metal in against flimsy sections of sand is, the risk of their being broken down by reason of the velocity of the molten metal. Even though such portions are nailed, or rodded, risks occur, increasing with the volume, and rate of travel of the metal. It should be introduced at a distant spot, so that its velocity will be considerably reduced before it reaches the weak sections, around which it will rise quietly, without causing fracture.

If metal is brought in against faces that have to be tooled, sponginess is likely to result. It is inevitable that the metal in the immediate vicinity of ingates should be honey-combed with minute blow-holes, specks and dirt. In such cases, when there is no alternative, extra metal should be allowed for tooling, as in the provision of head metal in Fig. 3, or a skimming gate may often be employed, as in Fig. 16, or risers may be placed adjacent, or skimming the metal may be

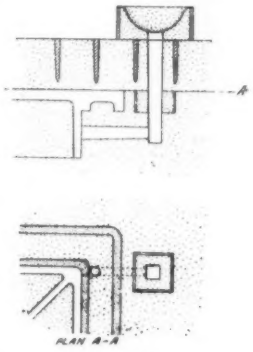

FIG. 6.

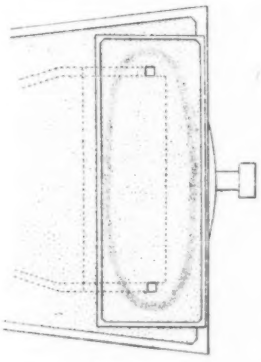

FIG. 7.

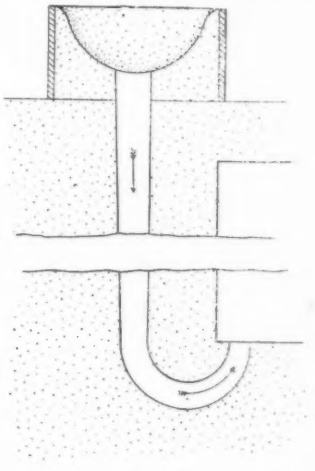

FIG. 8.

favoured greatly by the formation of a double pouring basin, as in Fig. 4. But with few exceptions, chiefly in the case of articles that have to be tooled all over, of which Fig. 16 is an example, it is possible to pour moulds elsewhere than against tooled faces. If one end, or one side only of a casting is to be machined, that may often be moulded downwards, and the pouring be from the top. Or the ingate can be placed against an opposite end or side, and risers included if thought desirable.

The differences between castings having considerable mass, and those which are light and flimsy, and, especially, too, when slender articles have large over-all dimensions are reflected in the forms of their runners and ingates. A single large round runner and ingate, of sufficient area to supply a slender mould with metal to flow to its extremities would produce a dangerous "draw" in the casting. Its removal would also be liable to cause damage, or the runner itself might be the cause of fracture of the shrinking casting. A design which is both thin and of extensive dimensions cannot be poured through one ingate. It must be filled at one end, or if long from opposite ends, with thin ingate, flat like, Fig. 13, or in the form of a spray, Fig. 14. Also it is well to bring the metal directly into a web, or webs, with vertical ingates and horizontal runners. Iron soon chills when it has to travel long distances in a thin mould, hence the reason why pouring from two sides or ends is desirable. The total area of the runners must be large enough to supply sufficient metal to fill the mould before the effects of chilling can be felt. And in such moulds, the iron is poured hotter than in those which are massive. It must be "dead melted" in the first place. The thinner the castings, the more gray must the iron be, since the mottled, and the harder grades will not run with such fluidity as the grey irons do.

Arrangements for pouring moulds in which the longer axis is set vertically, concern one group of castings almost exclusively, these are cylindrical castings, used for engines of all kinds, for hydraulic pressure cylinders, and their rams, and for many pipes, and some columns Vertical pouring is adopted in order to obtain close metal, free from all traces of honey-comb, metal consolidated by the liquid pressure due to the head, without which soundness, steam, or water ooze through the interstices, and fracture might occur under stress. Such work is, therefore, often cast in dried sand, or loam, and additional head metal is usually included, to receive sullage, to be cut off and thrown away. Such moulds are poured either at the top, or at the bottom, Fig. 8, or from both locations. Differences of opinion exist as to the relative merits of top and bottom pouring. Usually the first is adopted because it entails less work than the second does.

The common objection to top pouring only arises in the case of very deep moulds, as those of many hydraulic cylinders, and rams. It is, that the metal in falling, is liable to cut up the sides and bottom of the mould. If it is brought in at the bottom it rises quietly, inflicting no damage. This objection seems to be exaggerated, since little damage, if any, can occur in a dried sand mould, which is invariably employed. The cutting-up of the bottom can be prevented by driving in flat-headed chaplet nails level, with the sand, for the metal to fall on. The great advantage of top pouring is that the metal is maintained in a state of agitation while it rises, which tends to break up, separate, and bring to the top any dirt that may be present in the metal, or that may be gathered from the sides of the mould or core.

When top and bottom pouring are combined, the mould is partly filled from below, and completed from the top. This method is more advantageous in a deep green sand mould than in one made of dried sand or of loam.

The arrangement of ingates in vertical pouring depends on the diameter of a mould. One suffices for the smallest, two or three should be used when diameters of 9 in. to 12 in. are reached, but over this, ingates

should be distributed in a circle from a common pouring basin, Fig. 9.

The area and disposition of the ingates depends upon the varied dimensions and shapes that are adopted. Ample area must be provided to prevent the metal from chilling and causing cold shuts. Ingates rarely measure less than 1 in. in diameter, or equivalent cross-sectional area, or more than 3 in. or 4 in. diameter, or equivalent area. When more area is required, as in long or deep moulds, the number of ingates is increased, and pouring also may be done from two places.

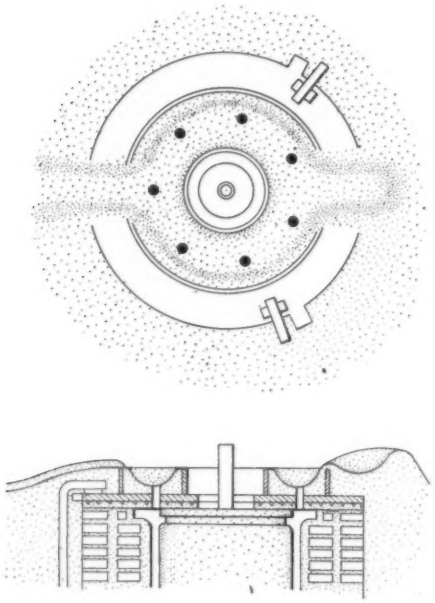

FIG. 9.

In many castings the ingate and runner are one and the same, but in a large number of moulds the runner is set at right angles with the ingate, as in Figs. 4 to 7, and in Fig. 12. The runners are tapered for withdrawal into their moulds. These are generally of rectangular sections. Fig. 13 shows a long, thin ingate, which has an area more than equivalent to very large runners of the shapes in Figs. 10 and 11, with the great advantage that it will not draw or fracture the casting. Fig. 13, like the alternative spray in Fig. 14, will also distribute the metal quietly in a moderate stream. The total area of an ingate should be in excess of that of the runners. Figs. 10 and 11 are the two commonest forms of runner pins.

The foregoing remarks relate to single castings, large and small alike. When a number of castings are mounted on a plate, they are connected by a series of runners with a single main ingate (Fig. 15). The ingate must be large enough to supply the whole of the castings with metal, but the runners need only be of small area. Numerous arrangements of this kind are made to suit patterns variously disposed. Sometimes the metal is led through successive moulds, with runners connecting them in series. This is suitable in cases where patterns vary much in dimensions. The sections of ingates for plated work are round or polygonal, those for the runners are similar, or they are flat with bevelled edges.

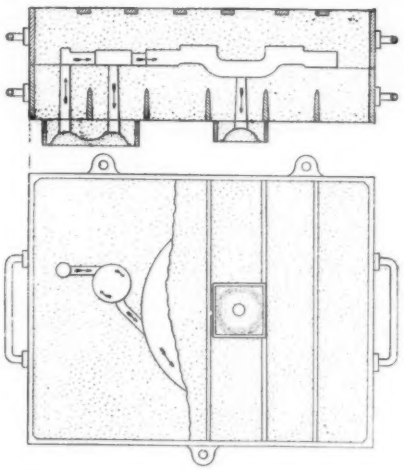

FIG. 16.

The shapes of pouring basins are not made haphazard, but to suit the conditions of the inflow of metal. The smaller moulds are filled directly, and for these a simple cup (Fig. 1) suffices to receive the metal from the ladle. But in all large moulds, provision is made for the basin to receive a considerable volume of metal before any of it can get into the mould. This is necessary for two reasons—one to prevent risk of small volumes falling in driblets while the spout of the ladle is being adjusted in the crane, the result of which might be cold shots in the casting, the other, to provide a receptacle for any scum that may pass the skimmer. Provision for these is made by forming a depression to one side, examples of which are seen in Figs. 2 to 5. The metal is poured slowly into the supplementary cup while the ladle is being adjusted, until the depression is filled and begins to overflow, at which stage the full volume of pouring is done. In large moulds, the basins are therefore of an oblong shape, and the depressed portion is of considerable length, when the mould requires a large quantity of metal, as in Fig. 4, often holding a cwt. or more. The method is also employed in vertical

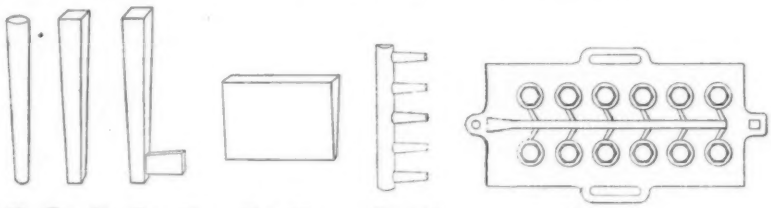

FIG. 10. FIG. 11. FIG. 12. FIG. 13. FIG. 14. FIG. 15.

moulds (Fig. 9), where an annular cup is flanked by a basin at the right, into which the metal is poured, and whence it overflows into the cup.

Pouring basins are extraneous to the moulding boxes. The simplest are little rings of iron (Fig. 1) laid upon the top of the flask, within which the pattern or the runner pin is stood, resting on the pattern being moulded. In all other moulds, any other box part, without bars or stays, as a middle part, or a small flask is selected of suitable size and shape (Fig. 7), and the basin is rammed and shaped with the hands within it. In Fig. 9 the basin is rammed between concentric rings.

Skimming chambers (Fig. 16) are special forms of runners, which have for their object the keeping back of dirt from entry to the mould. They are only employed when absolute freedom from foreign matter is essential, chiefly when articles have to be tooled all over. Centrifugal force is set up in the skimming chamber, which sends the heavier metal towards the outside, leaving lighter matters about the centre. To produce this effect the metal is brought in tangentially, so causing a swirl, and the more solid metal, free from dirt, enters the mould In small work, the lighter stuff may remain about the centre, but in larger moulds it floats up into a riser, set vertically over the chamber, as in Fig. 16. The chamber may be formed by ramming either a ball or a disc; the first is more efficient because of its larger capacity.

Risers or flow-off gates have in some cases the same general appearance as a simple cup-shaped ingate. In the larger sizes a flow-off gutter is provided, which conducts the surplus metal away. The special functions of the riser and the flow-off gate differ, though the two are often combined. The riser relieves the mould of strain. It has therefore its chief application in moulds with broad areas, where the liquid pressure of metal lifts the top box, and causes thickening of the plated portions of the casting. The exit is closed with a ball or plug of sand or clay during the pouring, which is washed away when the metal rises up. Another if its utilities is to receive the lighter, more open metal, and particles of dirt that float on the surface. More than one riser is often placed to receive these, and the upper part of a riser, as of an ingate, is always open-grained, and contains dirty matters that would have been detrimental to the casting. Risers will not undo the mischief caused by putting poorly melted, spongy and dirty metal into a mould, but they may be expected to remove sullage that has been accidentally introduced. The flow-off gate also relieves strain, but the term signifies the carrying off of an excess volume of metal to ensure the complete removal of any deleterious matters. This is the function of the gate in Fig. 9, where the question of strain is not involved. The annular pouring basin is kept full until after the mould has been filled. The sullage floats on the surface, and runs away over the flow-off gate. Head metal is rendered unnecessary, although the flange has to be tooled.

The location of risers varies with the forms of castings. Preferably they are situated as far as possible away from the runners (Fig. 17). Their position is also determined by that of masses of metal which have to be cast clean for tooling, or which are liable to draw, in which case the riser fulfils the additional function of a feeder head, as runners often do, being pumped with fresh supplies of molten metal, until freezing-up takes place.

The function of head metal (Fig. 3) is not quite the same as that of feeding. It is that of providing a reservoir into which sullage, air, and spongy metal collect, which would otherwise remain in the casting. Head will not prevent drawing, or open grain in the casting if its height is insufficient, or if its mass is not suitably proportioned to that of the metal below. Feeding of head, through the head to the casting below, is sometimes desirable. A large radius is necessary to facilitate the upward flow of the sullage from the mould into the head. Without the exercise of judgment, the mere addition of head will often fail of its desired object.

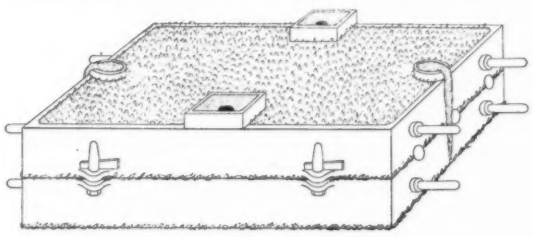

FIG. 17.

The Castings Trouble.

By "A. BUYER."

The moulders' strike has been over many months, and has been consigned, by the people at large, to the limbo of forgotten events. In the engineering factory, however, it is not permitted to be forgotten, for the after-effects are still taking toll of industry, and production is adversely affected on account of inadequate supplies of castings.

The buyer associated with the engineering factory is having an unenviable time, particularly if the factory does not boast a foundry, and he is dependent upon outside sources for his casting supplies. He is up against a stiff proposition, and he may be considered lucky if he can command 50 per cent. of his pre-strike supplies.

All foundries are similarly placed. Arrears have accumulated, and are having to be worked off, and on top of these new orders from regular customers are pouring in. How is it possible, therefore, for the new-comer to get a foothold when the foundry now has more than it can cope with? Wherever he tries he is greeted with the legend, "Full up." Large firms, possessing their own foundries, cannot get adequate supplies from those foundries, and so they are constrained to get outside help. In many cases they have bought up small general foundries, whilst in others they have acquired priority which effectively stops the ambitions of the small man. The writer, in his quest for castings, has had cases presented to him where the general foundry cannot accept orders from new people except with the consent of the large firm which takes away practically the whole of the foundry output.

It may be that after a time he succeeds in locating a foundry that will book his orders, but it does not

follow that his immediate needs in regard to casting supplies will be met, and too often this "success" only results in "tying up" certain of his patterns, which for months probably are therefore unproductive.

As may be expected, as a result of this unprecedented demand for castings, the price of the commodity has been forced up to alarming heights, this necessarily having a marked effect upon the selling price of the completed article. Worse than this, however, is the effect upon the quality of the casting.

It is well known that to-day engineering firms are accepting castings of a quality which, in pre-strike days, they would not put into process. Machining operations are costing more, cutters and tools are having their lives shortened, and high wages are being paid to "doctor" castings pitted with sandholes—yet the only alternative is to close the factory until such time as adequate supplies of good grade castings are available. And the alternative would in many cases spell ruin.

Accepting the fact that the late strike played havoc with industry, and that the work of overtaking arrears was formidable, can we say that the whole of the troubles now being encountered are attributable to the same cause? We must admit that, during the strike period, engineering firms depended solely upon their reserve stocks, and that these were exhausted long before the strike terminated. It followed, therefore, that immediately work was resumed in the foundries everybody was clamouring for castings, and, in the interests of fair play, supplies to any individual firm were strictly limited.

In the case of small easy castings, it is true that the supply pretty nearly equals the demand, but this type of casting does not, as a rule, constitute an assembled unit. More often than not, in an assembled unit there is at least one main casting, usually an intricate affair, and if this is not available there is not much satisfaction gained in contemplating the half-a-dozen smaller castings which are in evidence.

All engineering firms have leeway to make up, and their demands are, as a consequence, somewhat higher than the normal. But are the foundries taking the necessary steps to cope with the increased demand? We get excuses—plenty of them—but there is very little reformation in the foundry. The output has not diminished, but the engineering world is being flooded with "dud" castings at an exorbitant figure, and so long as the demand exists this state of affairs will remain. Yet what is the buyer to do? He has a hungry shop to satisfy, and just as a starving man will snatch at a bone, so also will the buyer, in such circumstances, eagerly grasp what is offered him. He dare not take upon himself the responsibility of refusing these castings—he dare not even remain passive—for he has so many dependent upon him. So he buys, and, as a consequence, he aids and abets the production of castings of the quality we are getting to-day.

During the strike many moulders forsook their trade and went into other occupations, from which they have not returned, whilst others, when work was resumed in the foundries, migrated to the foundries associated with the motor industry, where, it is alleged, they could command higher wages. That this should be so seems somewhat remarkable in view of the result of the strike, but now that the motor industry is suffering an eclipse there is hope that many of the moulders will return to the general foundries, where their presence is sorely needed.

But with their return will the production of inferior castings cease, and the pre-strike standard again hold sway? Or are the foundry managers so satisfied with the existing state of affairs as to desire its continuance? It is with regret that the writer allows such a doubt to appear, but circumstances do seem to point in that direction, and until the demand shows signs of diminishing it is to be feared that the temptation will be too strong to be resisted.

Salvation will be found, however, in those foundries where the quality of the goods is still the first consideration, and that such foundries do exist is well known to the writer. These, however, have suffered severely by the deflection of the skilled moulders, and they have had to "carry on" as well as possible. It was with no feeling of pride or satisfaction that they viewed their products, for to them "quality was the watchword," and they are looking forward to the return of their skilled operators, so that, in regard to both quality and quantity, the pre-strike level is again reached.

The writer is of the opinion that, in the main, the general foundry manager thinks only for to-day, and takes no thought for to-morrow. It is a very easy matter to shrug one's shoulders and say the thing cannot be helped, particularly when, without effort, the foundry is paying as it never has paid before. Easy is it also for the foundry manager to virtually hand his foundry over to a big concern, and allow this big concern to dictate the policy, but this is not management, and may have disastrous consequences. The present state of affairs will not last for ever. Sooner or later the supply will exceed the demand, and then will come the awakening. The buyer will be able to pick and choose, and it may be taken for granted that the treatment accorded him in his dark days will be remembered.

This quest for castings is not wholly unfortunate, so far as the buyer is concerned, for it has broadened his views, put him on his mettle, and forced him to develop characteristics which in the ordinary course of events would have remained dormant.

Catalogues Received.

We have received from Maison Veuve A. Casier, 57, Rue de la Folie-Regnault, Paris, particulars of their specialities in moulding boxes.

We have received from Alfred Herbert, Limited, Coventry, England, a brochure describing their No. 6 Plain Horizontal Milling Machine.

We have received from Messrs. J. H. Sankey & Son, Limited, fire brick specialists and manufacturers, Essex Wharf, Canning Town, E., a list of temperature indications by colour compiled by them from the best authorities on metallurgy, refractories, etc. It is pointed out that there is a great diversity of opinion on the actual melting, disassociation, boiling and freezing points, etc., of some of the substances given, but the figures will be found to be sufficiently approximate to be of practical utility. The list does not give flame temperatures, with the exception of the oxy-coal gas, as authorities differ to such a great degree owing to the varying conditions which have to be contended with. The senders will be pleased to supply any of our readers with this temperature list on request.

We have received from the British Aluminium Company, Limited, 109, Queen Victoria Street, London, E.C.4, a booklet, giving illustrations and sizes of representative aluminium shapes.

The Romiley Motor Company, the Garage, Compstall Road, Romiley, advise us that they have decided to change their name to The Romiley Motor and Engineering Company. Having purchased the premises situate at Barrack Hill, Romiley, which are equipped with power, and in which they have installed machinery for carrying on general engineering work in conjunction with iron and brass founding, and are prepared to execute orders for repetition castings in large quantities both in iron and brass. They will also specialise in producing special metals for bearings, both self-lubricant, and anti-friction.

THE

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NOTES AND COMMENTS.

Another Deoxidiser for Cast-Iron.

In our March issue we commented on the use of ferro-cerium as a deoxidising agent for molten cast-iron introduced by Dr. Moldenke at the 1919 Convention of the American Foundrymen's Association. At the recent meeting of the American Foundrymen's Association, Dr. Moldenke has added yet another deoxidiser to the already extensive list in the shape of ferro-zirconium. We publish in our columns an abstract of Dr. Moldenke's paper describing this new alloy.

We are really surprised at such an authority as Dr. Moldenke attributing the influence of an addition of 0.15 per cent. zirconium in raising the transverse breaking strength of cast iron by 350 lbs. to the deoxidising effect of the zirconium addition, when on his own showing this element has "given trouble and chilled the metal considerably, so that it was difficult to pour successfully." We ourselves should have been more inclined to search for an explanation of this effect by a study of the condition of the carbon, particularly in view of this experience.

In fairness, we must add that Dr. Moldenke apparently considers that ferro-zirconium "will do better service in steel than in cast iron." In spite of this, we and many other foundrymen would be very glad to see the figures and data on which Dr. Moldenke bases such statements as "The first effect of deoxidisers . . . is the removal of oxygen present in combination with the iron." and "It is the removal of oxygen—the weakening factor in the molten metal—that permits it to come out with its natural strength due to its composition."

Die-Casting Aluminium Bronze.

Before the March meeting of the Institute of Metals in 1918, Messrs. Rix and Whittaker described some of their experiments on the production of die-castings in aluminium bronze. From the photographs and the actual castings exhibited by these investigators at that meeting one certainly gathered the impression that die-casting was an accomplished fact. We were consequently surprised to read that Mr. Pack was responsible for a statement before the American Foundrymen's Convention that the casting of brasses and bronzes in metal moulds was an impossibility and not being done practically at the present time.

In a recent issue of the "Iron Age," however, we notice that Mr. T. H. Jeacock, President of the Buffalo Bronze Die Cast Corporation, writes that his firm has been engaged in the production of aluminium bronze die-castings for the last three years.

"The smallest pieces they have run weigh 360 to the pound and the largest piece 12 lbs. They have cast an outside thread on a casting made in two pieces which when assembled had to be in perfect alignment. The thread was 20 pitch. They have run a die well past the 35,000 mark. They have accomplished the coring of holes, with metal cores, to a degree of accuracy of plus or minus one-half thousandth of an inch on holes ½ in. in diameter and as deep at 1½ in.; on casting of teeth on bevel gears as large as 4 in. in diameter to a degree of accuracy on tooth parts of plus or minus one-thousandth. They have been commercially casting teeth in worm gears in metal dies for two years. Their deliveries on this piece have run as high as 500 per day. The gear weighs 12 lbs."

Correction.

We regret that in error we referred to Messrs. Joseph Cook, Sons & Company as Messrs. Thomas Cook, Sons & Company, in describing their new steel foundry recently completed at Washington, Durham.

Costs of Steel Melting.

In his Presidential address at the ninth Annual Conference of the British Commercial Gas Association, which was recently held at Sheffield, SIR ROBERT A. HADFIELD, BART., submitted an interesting table giving a comparison of the cost of heating and melting steel and iron in coal, gas, open-hearth, crucible and electric furnaces, etc. He remarked that producer gas was now used almost universally to produce the high melting temperature required, some 1,600 to 1,800 deg. C., employed in the manufacture of steel produced in the open-hearth process. Probably 80 per cent. of the world's output of steel was made by this process. For 1920 the total production by all processes would amount to something like 70 million tons of steel, including the gigantic output by the United States, which alone was expected this year to total about 42 million tons.

The average quantity of coal used was about 6 cwts. per ton of steel melted, so at least 25 million tons of coal were now being used by the world, probably involving the production of no less than 3½ million million cub. ft. of gas for use in open-hearth gas furnaces throughout the world. Some 45,000 to 60,000 cub. ft. of producer gas from coal would melt one ton of steel, the thermal units of the fuel being 9,400,000 B.T.U. Of this probably not more than 13.5 per cent. of heat efficiency was utilised, and no less than 86.5 per cent. was lost. In studying the table it should be borne in mind that the figures were based upon the prices prevailing in 1918 of coal, 20s. per ton, gas 1s. 4d. per 1,000 ft., and electric energy 0.72d. per unit. As the prices now were just double what they were at the time the data was prepared, the whole of the costs given would require doubling. The average price of coal from which producer gas was prepared was 39s. 5d. per ton.

In compiling the above table the calorific power taken for the various fuels is as follows:—1 electrical unit = 3,440 B.T.U.; 1 cub. ft. coal gas = 650 B.T.U.; 1 lb. coal = 14,000 B.T.U.; 1 lb. crucible coke = 13,000 B.T.U.; 1 lb. cupola coke = 13,000 B.T.U. The figures in the table are based on war prices early in the year 1918. In ordinary times coal should not cost more than 12s. per ton; gas, 10d. per thousand cub. ft.; electrical energy, 0.4d per kw.-hr. If these prices were taken, the above costs would then be correspondingly reduced. The average specific heat of steel between 0 deg. C. and 900 deg. C. equals 0.16.

Comparison of Coal, Gas and Electric Furnaces for Heating and Melting Steel and Iron. (Based on one ton of Steel or Iron, heated or melted.)

	Amount of fuel or energy consumed.	Thermal Units in fuel (B.T.U.).	Cost of fuel. Price.	Cost of fuel. Total cost.	Heat efficiency. %	Lost heat. %	Tons of coal used in producing fuel or energy. Tons.	Tons of coal used in producing fuel or energy. Quality.
			HEATING ONE TON OF STEEL TO 900° C.					
	COAL HEATING.		s. d.	s. d.				
(A) Theoretical 100% efficiency	0.0182 ton (41 lbs.)	570,000	20 0 ton.	0 4½	100	Nil	0.018	Ordinary
(B) Practical	0.08 ton (179 lbs.)	2,510,000	20 0 ton.	1 7	23	77	0.08	„
	GAS.		s. d.					
(A) Theoretical 100% efficiency	877 cubic feet	570,000	1 4 1,000ft.	1 2	100	Nil	0.073	Bituminous
(B) Practical	2,750 cubic feet	1,790,000	1 4 1,000ft.	3 8	32	68	0.23	„
	ELECTRICAL.							
(A) Theoretical 100% efficiency	163 units	570,000	0.72d. unit.	9 9	100	Nil	0.21	Boiler coal
(B) Practical	300 units.	1,030,000	0.72d. unit.	18 0	54	46	0.38	„ „
			MELTING ONE TON OF IRON IN THE CUPOLA.					
	HEARTH.		s. d.	s. d.				
Practical	0.15 ton coke (336 lbs.)	4,370,000	52 0 ton.	7 9	23	77	0.225	Coking coal
			MELTING AND FINISHING ONE TON FLUID STEEL.					
	CRUCIBLE.		s. d.	s. d.				
Practical	2.50 ton crucible coke.	73,000,000	47 0 ton.	117 6	1.4	98.6	3.75	Coking coal
	OPEN-HEARTH.							
Practical	0.30 ton producer coal.	9,400,000	19 0 ton.	5 8	13.5	86.5	0.3	Producer coal
	ELECTRIC, TO MELT.							
Practical	515 units.	1,780,000	0.72d. unit.	30 11	68	32	0.66	Boiler coal
	ELECTRIC, TO MELT AND REFINE.							
Practical	780 units.	2,680,000	0.72d. unit.	46 10	47	53	1.0	„ „

Book Received.

We have received an illustrated handbook issued under the auspices of the City Council (Development Committee), Cardiff, setting out the achievements and possibilities of that city in commercial and industrial enterprise. The work is thoroughly representative of the various departments of activities for which Cardiff is already well known. Naturally, shipping and coal are prominent among the industries mentioned, but we miss any reference to the local iron and steel industries.

The Induction Electrical Furnace.*

By G. H. Clamer.

An interesting comparison between the average modern brass foundry for the production of ingots for rolling and the ancient foundries, as illustrated in "Untererdische Hofhaltung," Ecker, 1682, shows that the methods of melting, handling, pouring, and the type of mould used in those early times were not radically different from the methods and equipment in

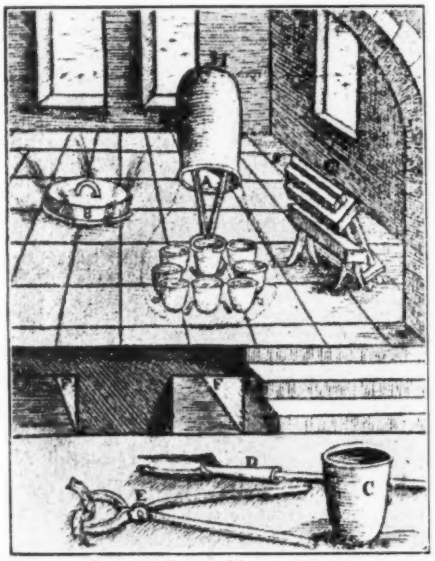

FIG. 1.—ANCIENT BRASS MILL. ILLUSTRATION IN ECKER'S "UNTERERDISCHE HOFHALTUNG," PUBLISHED IN 1682.

use at the present day. The illustration of this early foundry is shown in Fig. 1.

Turning to those physical properties of brass which are of primary importance in all considerations of its melting, the writer refers to the curves prepared by Gillette, of the Bureau of Mines, and shown in Fig. 2.

The upper curve is a plotting of the temperatures at which zinc is volatilised from the various alloys, and the intermediate curve shows the necessary pouring temperature These curves are of particular interest in showing in graphic form the small margin in temperature between the pouring temperature and the point at which zinc volatilises from those alloys that are of greatest commercial importance, namely, those containing between 30 and 40 per cent. of zinc.

It is these underlying facts in connection with such alloys that make us turn our attention with so much assurance of success to the electric furnace. It is only in an electric furnace which provides an absolute temperature-control that it becomes possible to pour with certainty at the correct temperature, and at the same time reduce the loss of zinc by volatilisation. In the induction furnace, of proper design, in which heating results in the metal bath itself, ideal control is assured

The brass mills have experimented from time to time with oil and gas furnaces, both of the open-flame type, and tilting crucible furnaces, holding large crucibles. Experience has proved that the average quality of the brass melted in such furnaces will not satisfactorily meet commercial demands. Such brass lacks uniformity, and is oxidised, and often sulphurised, due to its contact with excess of air and fuel gases. The metal losses in such furnaces, due to oxidation and volatilisation, are excessive.

It is for the above reasons that the old type crucible furnace, with its homœopathic charges, has been adhered to until the advent of the electric furnace.

Fig. 3 indicates losses of heat in melting metals, in the various forms of furnaces. The light spaces showing the proportion of the heat utilised, and the dark spaces the proportion of heat wasted.

Electric furnaces have been variously classified, but a general classification can be made under two heads:

(1) Those in which the heat is transferred to the metal from an outside source.

(2) Those in which the electrical energy is converted directly into thermal energy in the metal to be heated, due to its resistance to current flow.

It is the latter type of furnace that is most extensively used in the wrought-brass industry, and it is this type of furnace to which reference will be made. Such a furnace is in reality a current transformer, and is known as an induction furnace.

When an electric current flows through a conductor,

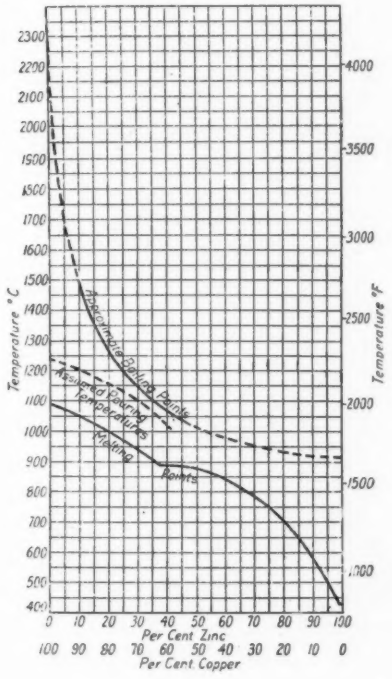

FIG. 2.

magnetic lines of force are formed around the conductor in concentric rings. If the current is discontinued. this field dies down similar to a rubber band that is stretched into a large circle and then released. These lines of force, in dying down, cut the conductor. Whenever lines of force cut a conductor, a voltage is

D

* Abstract from a paper presented at a joint meeting of the Institute and the Philadelphia Section, American Institute of Electrical Engineers.

induced, and if the electric circuit is placed so that the lines of force from the first conductor will cut it, then a voltage will be induced in it. With an alternating current, the value of the current, and, hence the number of lines of force, is continually changing from zero to a maximum and then back to zero. The rate of this change is called the frequency. In order to increase the number of lines of force and have them take a certain path in order that as many as possible of the lines will cut all of the conductors, iron is used to interlink the conductors. Air is a poor magnetic conductor; iron is many times better. The induced voltage is proportional to the number of cuts in unit time. For example, if we have 1,000 lines of force cutting 10 conductors in one second, a certain voltage will be induced. Now, if we double the lines of force or double the number of conductors or cut the time in half, the voltage will be double. We may now express these three conditions in a formula:

$$V = C \times F \times T \times L$$

V = the voltage, C = a constant, F = the frequency, T = the turns, L = lines of force.

The combination of two coils and an iron core interlinking them constitute what is called a transformer. By means of a transformer any voltage desired may be obtained, either higher or lower than the supply voltage. The formula applies to both coils of a transformer, the primary coil being the one connected to the supply; the secondary coil the one with the changed voltage. As the constant C, the frequency F, and the number of lines L are the same for both coils, then it follows that the voltage is proportional to the number of turns. This may be expressed in a different way, as follows: "The voltage per turn is a constant."

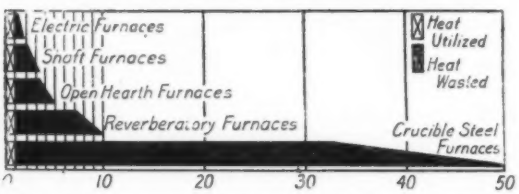

FIG. 3.—INDICATING HEAT LOSSES IN VARIOUS TYPES OF FURNACES.

For example, if the primary voltage of a transformer is 220 and the primary coil has 22 turns, the voltage per turn is 10. Now, if the secondary coil has 5 turns, its voltage will be 5 × 10, or 50. If the turns of the secondary be changed to 10 turns, its voltage will be 100. The efficiency of a transformer will average about 97 per cent., therefore, for simplicity, we may say that the input equals the output. Let P_1 equal the primary power, P_2 equal the secondary force, E_1 equal the primary volts, E_2 the secondary volts, C_1 the primary current, C_2 the secondary current, T_1 the primary turns, T_2 the secondary turns. Then

$$P_1 = E_1 \times C_1 \qquad P_2 = E_2 \times C_2$$
$$P_1 = P_2 \qquad E_1 \times C_1 = E_2 \times C_2$$
$$\frac{C_1}{C_2} = \frac{E_2}{E_1} = \frac{T_2}{T_1}$$

The current is inversely proportional to the voltage and inversely proportional to the number of turns.

The foregoing rules are of great importance in the design of transformers and also of induction furnaces, for an induction furnace is simply a short-circuited transformer under control. It is an ordinary transformer in which the secondary is formed by molten metal.

There are two injurious factors to guard against in the design of horizontal open-ring induction furnaces—namely, "pinch effect" and low-power factor.

"*Pinch Effect.*"—When high currents are sent through molten conductors, the cross-section of the conductor tends to contract. This contraction will, if the current be sufficiently increased, finally interrupt the circuit at the point of smallest cross-section. This does not occur when steel is being melted in the induction furnace, if the furnace be not forced. Because of the high resistance of steel, the current required to melt is not sufficient to cause the "pinch effect." But, in the case of low-resistance metals, as copper and brass, "pinch effect" interferes with the proper running of the furnace. This condition occurs only in induction furnaces which have the molten secondary in a horizontal plane, and of the open-channel type.

The first induction furnace was invented by Edwin Colby (Fig. 4), of Newark, N.J. This was a simple ring type of furnace in which the secondary consisted of a single turn of molten metal interlinking a magnetic circuit. In the Colby type of furnace, the primary coil was placed outside of the secondary circuit. Colby was in the platinum business, and his desire was to produce a furnace in which platinum could be melted in a non-carbonaceous atmosphere. Platinum, when melted in contact with carbon, absorbs that element to some degree and makes it difficult to work. Colby did not succeed commercially in accomplishing that which he set out to do, but he did give to the world a type of electric furnace which for many other purposes has been developed into one of great usefulness and importance. From a theoretical standpoint, this type of furnace is of the highest efficiency, and is one in which the charge of liquid metal is under perfect temperature control. In the induction furnace the heat is generated within the metal itself, and the current flow is absolutely steady, because of the constant resistance.

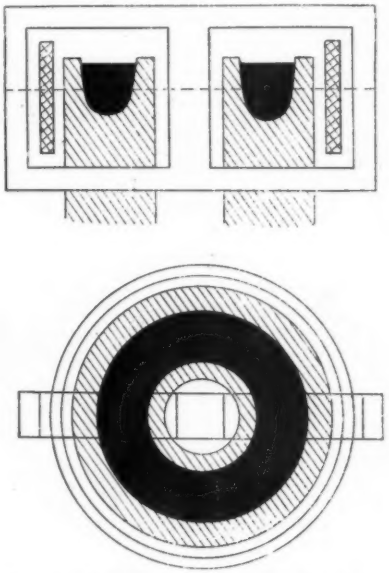

FIG. 4.—ORIGINAL OPEN CHANNEL INDUCTION FURNACE AS INVENTED BY E. A. COLBY, 1888. IN THIS FURNACE IS EMBODIED THE BASIC IDEA UPON WHICH WAS FOUNDED THE INDUCTION FURNACE ART.

The author goes on to describe the underlying differences in the different patented types of induction furnaces. The patents of Ferranti, Kjellin, Röchling-Rodenhauser, Frick, Gronwald, and the General Electric Company are reviewed in some detail.

A patent to James R. Wyatt, illustrated in Figs. 5 and 6, discloses an open ring furnace of the Röchling-Rhodenhauser type, in which is provided more rapid circulation due to "motor effect," which occurs at the acute angles "36" because the current path at such points takes opposite directions.

A furnace invented by Bally operates on an entirely different principle than the many other furnaces before exhibited, in that inductive effects result in this furnace by reason of a rotary field and a stationary armature. If in an induction motor the armature is so wedged that it cannot rotate, it burns out, because of the rapid conversion of electrical energy into heat instead of motion. In this furnace the bath to be heated is the armature. The inductor with an exciting current rotates within the annular bath or armature and heating thereby results.

All the furnaces thus far described are of the open-channel type.

Dr. Schneider, of Creusot, was the original inventor of the closed channel induction furnace. This particular type of furnace was not successful because the circulation was sluggish and overheating resulted in the resistor channels.

Other closed channel furnaces have been invented by Deferranti and Wallin.

The author describes in detail the origin of the "pinch effect," or flow of the molten metal in certain shaped furnaces. He describes a series of experiments undertaken by Wyatt in the design of a suitably shaped melting cavity to obtain efficient circulation of the molten charges under the influence of the current.

In the Ajax-Wyatt furnace it is possible to melt

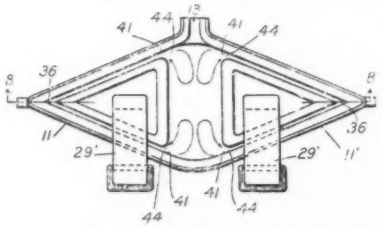

FIG. 5.—AJAX-WYATT FURNACE OF OPEN CHANNEL TYPE IN WHICH AN IN AND OUT CIRCULATION IN EACH END OF THE SECONDARY LOOP IS PROVIDED.

60/40 brass without volatilisation of zinc in the channels of the secondary circuit, so long as the cold metal is being fed into the furnace, or the bath, in its entirety, has not reached the temperature at which the zinc is volatilised. It is interesting to know that just as soon as the bath reaches the correct pouring temperature, the needles on the instruments begin kicking. The test now used by the melter in the brass-rolling mills to determine the casting temperature is to immerse an iron bar in the molten metal. If the melter feels a kick upon the bar, he pronounces the temperature satisfactory. This kick that is felt is simply due to the so-called boiling of the metal, i.e., volatilisation of zinc.

The furnace Ajax Wyatt may be fed with turnings, cabbaged material, ingots, etc. The charge may be added rapidly as there is no danger of solidifying the metal in the secondary channels or in the lower portion of the pool above them, the only precaution necessary being to exercise care to prevent bridging of the charge. The furnace is entirely noiseless in its operation, very cool on the outside of the jacket, uses no water in cooling, therefore, absolutely safe from any danger of having the heated metal come in contact with water and its consequent results. The shape of the hearth closely approximates that of an ordinary crucible, in fact very closely approaches the ideal for minimum of heat losses, which is a spherical form.

It is possible to tightly seal the furnace to prevent oxidation. The heat is generated in the charge itself, and at the bottom of the charge. All the forces effective in the channels have the tendency to carry the heated metal upwards, viz., motor effect, "pinch effect," and Joule effect, and so bring it in contact with the metal to be melted, consequently there is constant and energetic automatic circulation. The conditions in all these respects are ideal for high efficiency and minimum of metal losses.

The power factor of a 30-kw. furnace is 85 per cent. and of a 60-kw. somewhat less. The load is a perfectly steady one, so that from the power-house standpoint, such a furnace load is as desirable a load as could be imagined. On furnaces that are operated on 24-hour-day schedule, the load factor approaches nearly 100 per cent.

The earlier Ajax-Wyatt furnaces have now been in commercial use in Bridgeport Brass Company mills for a period of three years. This particular mill has now twenty-four of these furnaces in operation, and the total output of these furnaces, since the first one was installed, is upwards of 100,000,000 pounds. So successful has been the use of this furnace in this particular mill that the old method of melting has been entirely abandoned.

In another mill twenty-four 60-kw. furnaces are in

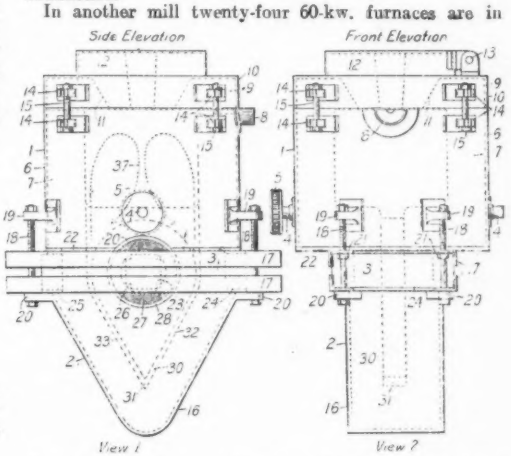

FIG. 6.—SHOWING THE VERTICAL RING FORM OF AJAX-WYATT FURNACE.

operation, in another sixteen 60-kw. furnaces, etc. The total tonnage of brass melted per day in the furnaces already installed and under construction approximates 1,500,000 pounds.

The amount of brass melted per kilowatt hour is from seven and one-half to eleven pounds, depending on the power input of the furnace, and the nature of the charge.

The theoretical figure as determined by the United States Bureau of Standards, and other competent authorities, is given at twelve and one-half pounds per kilowatt hour. This figure is based on melting two-to-one yellow brass, and bringing it to a proper casting temperature, 2,000 deg. F.

In continuous melting with the 60 kw. furnace, and taking the kilowatt hours used from Monday until Saturday, and dividing into the number of pounds charged, the week-in and week-out melting rate is shown to be eleven and one-quarter pounds per kilowatt hour, indicating an efficiency of 90 per cent. This leads one to doubt the theoretical figure.

A brief summary of the cost of operation of the Ajax-Wyatt furnace as compared with the old style "Pitt furnace" can be made in the following short statement:—

Repairs: Repair cost on electric furnace no greater than repair cost on pit furnace.

Power: The cost of electric power as compared with hard coal fuel is practically the same.

Saving: In addition to the above there is a great saving in labour, and crucibles are entirely eliminated Metal loss is reduced to an average of under 1 per cent., and from 5 to 10 per cent. more metal goes into production instead of scrap. This total saving amounts, very conservatively, to ½ per cent. per pound on the metal melted.

In addition to the above actual savings, there is produced a better quality of brass because of the perfect control of mixture and heat treatment, thus causing a minimum of rejections. Also, there is a decided bettering of the working conditions, an advantage which cannot be directly expressed in dollars.

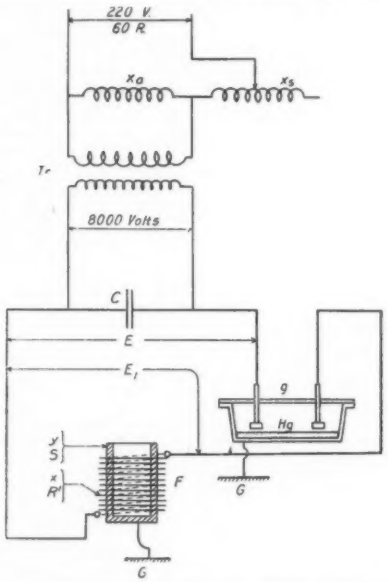

FIG. 7.—OSCILLATORY CURRENT SYSTEM INVENTED AND DESIGNED BY E. F. NORTHRUP FOR PRODUCING HIGH-FREQUENCY OSCILLATORY CURRENTS.

In the Ajax-Wyatt furnace has been found for the first time a satisfactory device capable of replacing the ancient crucible and pit furnace. Its use in the brass mills in America is extending with remarkable rapidity.

The furnace is made in two general types. One tilting upon a central trunnion and another tilting with the pouring spout as the centre of oscillation. This latter type of furnace is, of course, counterweighted for ease of manipulation. It is the latter type that is now used exclusively in the brass mills, because it permits of very satisfactory direct casting into moulds. This feature, from a practical standpoint, is one of decided importance.

Dr. Northrup has succeeded in developing a commercial furnace of satisfactory power factor, using currents of relatively high frequency, namely, 10,000 to 12,000 cycles per second. When currents, having frequency of the magnitude stated, are used, splendid inductive effect is possible without interlinkage of magnetic circuit. It therefore becomes possible to heat a body of conducting material contained within the walls of a plain cylindrical form of hearth or crucible. No resistor column of molten-conducting material is necessary. Because of this fact, this furnace has a far greater degree of flexibility in its operation than is possible in any other form of induction furnace. For example, it is possible to completely melt the full contents of the hearth, then entirely discharge its contents and recharge with solid material. It thereby becomes possible to change from one mixture to another without inconvenience or shut down. In fact, the furnace has all the flexibility of operation common with the ordinary crucible-type or fuel-fired furnace.

It has been found most convenient and satisfactory in the construction of furnaces under 20-kw. per phase, with a maximum therefore of 60 kw. on a three-phase circuit, to use as a source of high-frequency current, oscillatory discharge of a bank of condensers. By properly proportioning the capacity and inductances of the oscillatory circuit, the desired frequency is obtained. A 60-cycle line current may be supplied at the existing voltages. A transformer steps this e.m.f. up to 8,000 volts. A bank of condensers connected as indicated in Fig. 7 is discharged at this voltage and upon rupture of the spark-gap oscillations occur. The current with high-frequency oscillations passes through the inductor coil, which surrounds the crucible or mass to be heated.

A comparison from the commercial viewpoint of these two types of induction furnaces, namely, the Wyatt and the Northrup, from our present knowledge and viewpoint, is as follows:—

The Wyatt furnace is the most efficient electrical furnace as yet developed. The efficiency is so high that further improvement in this direction can be but trifling. It is exceedingly simple in construction and operation. Its electrical characteristics are of the best, and power factor of 80 per cent. is considered quite satisfactory by power companies. As at present developed, it is for single-phase operation, but satisfactory two-or three-phase furnaces will no doubt be developed in the future.

If a sufficient number of furnaces are in use to balance the phases, namely, two furnaces or multiples of two on the two-phase line, and three furnaces or multiples of three on the three-phase line, the load is entirely balanced.

Small furnaces give greater flexibility of operation, but the first cost is naturally higher if two or three times the power were used in a single unit. As a portion of the charge must always remain in the furnace, it is not practicable to frequently change from one mixture to another. Furthermore, as a liquid charge is necessary for starting, it is not a furnace that can be conveniently started. It is a furnace, therefore, which should be used for 24 hours per day operation, or, if used for intermittent operation, a sufficient amount of current should be kept on to supply the heat losses. This on a 60-kw. furnace is about 8 kw.

A further limitation has been put on the furnace in confining its field to melting alloys low in lead, because high lead alloys penetrate the lining material. With improved methods of lining, and a more satisfactory lining material, this drawback will also be overcome. Recent experience in this direction is very promising.

The Northrup furnace, as before stated, can be more conveniently used in intermittent service than any other furnace thus far developed. As the refractory material used is an absolute minimum in quantity, the first heat of the furnace can be taken off with almost the same rapidity and efficiency as the second, there being no great mass of refractory material to be first heated, as in other furnaces.

It is not believed that this type of furnace, because of its lower efficiency and greater cost of installation, owing to the intermediate high-frequency generator that must be used, can hope to compete with the Wyatt furnace in performing in the class of service for which this furnace is particularly applicable.

Institution of British Foundrymen.

LONDON BRANCH.

The first meeting of the session was held at the Cannon Street Hotel on Thursday, October 14, Major D. Gordon, O.B.E., R.A.F. (President), in the chair.

Presidential Address.

THE PRESIDENT, in delivering his Presidential address, said that he had noticed on the programme he was supposed to give some of his experiences during the war. This was very difficult, because who of them did not do something during the war, either in the way of rapid production or in the noble sacrifice of one's life? He had taken the trouble to look up statistics regarding the foundry trades and how they came through the war. This was difficult, because fettlers, core makers, moulders, etc., all came under different categories, but the foundrymen, so far as fighting men were concerned, really had come out where he had expected they would, near the top. It might interest them to know that, on both eastern and western fronts, they had travelling workshops, which were, of course, partly composed of foundries. Usually they used American fires, and the sand was sometimes conveyed to them from England and sometimes bought from the French. The men had repaired and made small parts of guns, and so on, so that instead of sending these to England they were able to get the work done at the base, and when they considered the skill and craftsmanship required in the ordinary course of events to produce a casting it would be realised how difficult it was, working under very disturbing influences, to obtain the same article.

From the foundry industry there were many young fellows who had gone out, and when they came back they had to start afresh, and it seemed to him that it was the duty of the Institution of British Foundrymen to help these fellows to get on. He did not know whether the members were aware of the fact, but both the army and the navy had got together and were trying to see what could be done, not only for the foundrymen but for every trade and profession. So far as the colleges were concerned, they did not help a bit. The examinations which were in force before the war were the same to-day, and no allowance was made for any fellow entering, say, his final for any examination. To his mind that seemed hard, but, on the other side, it told for efficiency, and if England was going to be supreme it must be the most efficient nation.

He had seen a good deal of what the foundrymen were doing during the war, and the impression which struck him chiefly was the social rise of the foundryman. Not so many years ago the foundryman was looked upon as a kind of sand rat, working in his own burrow, and it was considered just as well to leave him alone; the average fitter or turner or pattern maker thought he was well above the foundryman; but now things seemed to be quite different, and in looking for the cause he did not think the foundrymen had themselves to thank for the change that had come about. It was due to somebody entirely different—the chemist. The chemist had come along, and with the knowledge which he had used in foundry practice he had spurred the foundryman on to learn something about chemistry, with the result that his education had gone up by leaps and bounds. They had to thank the chemist in that respect, for he had come along and said that there was really something more in this foundry job than turning over sand and ramming up a box, and the employers themselves had begun to study what foundry work really was. Previously, it was not considered that the intellect of the foundryman was very high, but one of the best men in the Labour group in Parliament was a foundryman, and the Institution of British Foundrymen was composed of some of the brighter sparks of the foundry industry.

Looking at some of the other points in the foundry industry, it seemed to him that the average foundryman did not trouble about the industry as a whole apart from his own particular job. He did not study the commerce of the whole business. Any proprietor of a foundry was very diffident about putting a man in entire charge. He might know his business from beginning to end, the metallurgical and chemical aspects, because he is studious, but he does not study the commercial side. It seemed to him that if the foundryman were to give a little more attention to this and leave a little of the other alone it might be to his advantage. He was afraid he was breaking down a lot of their own thoughts and traditions, but he felt that he ought to say these things, and pointed out that it was common sense. They did not work in a foundry for fun; they were out to make money. He knew one or two foundrymen who could have been managers of engineering works, but their commercial knowledge was lacking. When he spoke of commercial knowledge he meant, of course, that the foundryman had not got to think of cheap production in his own department only. He had to look a little further, and see whether the whole product was being produced economically, that is to say, an engine or whatever the finished article was to be. He himself had had a good deal to do with proprietors, and they could take it from him that many were of the opinion that there was no *business* in the foundryman. It was up to them to prove the contrary.

Dealing with the problem of apprenticeship, Major Gordon said that they hoped to get a lecture from one of the members of the London Branch on this question. They had had one some years ago from Mr. Hayes, and there had been a long controversy in THE FOUNDRY TRADE JOURNAL about it, but he thought that they would get something worth while in the apprentice. It had been the practice to take into a foundry any boy that came along. They did not consider whether he was going to be any good, they did not question his forbears, or what he did at school. The boy should be given the opportunity to enter the foundry straight from school. Soon the age at which a boy could leave school was to be raised from 14 to 16. He thought that during the last two years the boy should go to a trade school, where he could see the conditions in every variety of trade and pick out what appealed to him. He remembered when he first went into a foundry he gloried in making himself very dirty, in order to let people see that he had been at work. The average foundryman could be more or less clean, more so than the fitter or the turner, because, whereas the latter had to deal with oil, the foundryman had to deal with sand, which could be easily brushed off. The average boy took

exception to a dirty trade, but if he saw the real working conditions he thought they would get a better class of boy entering the foundry industry and carrying on the traditions.

Another point which Major Gordon mentioned was that of turning the Institution of British Foundrymen into a Royal Institute. This idea had been thought of about four years ago, but they were short of money, and they wanted to get a Royal Charter. If they were to get respect in this world they must make out they were somebody. It had struck him that if they were to make the Institution something worth while and difficult to get into they would find men clamouring to be in. They did not find professors and so on wanting to get in. The average foundryman, or moulder, did not want to, because he thought his employer would belong to it, and he he did not want to be in with him. He did not know what the privileges connected with a Charter really were, but he thought that they paid their money, and they were called Royal, and had letters after their names. Most of the money for the Charter had been collected. Mr. Firth, a former president of the Institution, had provided a fairly large sum, and other members had come forward, and it was hoped to get the whole sum required by next year. A large sum of money had already been collected. The great advantage was that the Institution would be more difficult to get into. It seemed to him that it was difficult for the merchandising interests in the foundry business to get into the Institution. If a man sold blacking brushes he was not able to become a member, but if a man made a fire in a foundry he could join. It might, of course, come to pass that they would only be too glad to get the merchants in, and he was of the opinion that if the industry utilised these people they ought to enjoy the same privileges as themselves. He thought they ought to be made at least Associates.

Continuing, the President referred to the question of getting diplomas, and said it seemed to him that the younger members ought to come forward for these. There were diplomas given for the best paper of the year, and also the Stubbs Medal. He himself had been awarded the first diploma in the London Branch. He was very proud of it.

Dealing with the Delegate Fund, about which a letter was being circulated to all members, the President said that the Branch had sent delegates to attend meetings all over the country, and they had been paying hotel and travelling expenses out of their own pockets. He did not think that was the right thing, and if they were going to utilise the services of the delegates, the least they could do was to pay their hotel bills and railway fares, especially when they had been increased to such a large extent. He considered that they had been trespassing on the good nature of the delegates, and also, of course, upon that of the Branch secretary.

Referring to the question of attendance and membership during the coming session, he thought every member should make it a point to try and introduce at least one other new member. The Birmingham Branch were doing very well in this respect, and he was always a little afraid of Birmingham. He contended that the headquarters of the Institution should be in London; but the Birmingham Branch had thought otherwise, and they had tried to get headquarters established there in consequence of the work they were doing for the Institution. The General Secretary's office was now in London, and he thought the central headquarters ought to be there, and it was up to members to assist by bringing new members along and turning up in large numbers. He considered that it was a compliment to the lecturer for members to turn up, even though they did not agree with what he had to say. The lecturers went to a great deal of trouble and spent much time writing a paper, and therefore the members should attend and hear what he had to say. There was always, of course, something to be learned.

Discussion.

MR. J. A. GASKIN asked where a young foundryman could attain that commercial knowledge to which the President had referred. He knew a young foundryman who had paid for a course of book-keeping and commerce, who advertised for a position, and had received one magnificent offer of £350 a year for his services, and he was a practical foundryman. With regard to boys coming into the foundry, he thought that when they saw the work to be done and then happened to walk round the machine shop and saw the fitters and turners at work, there was a possibility that they might ask to go into the machine shop.

THE PRESIDENT said that the difficulty was that all boys liked to get into the machine shop and see the wheels go round. When a boy was put on the hard, laborious work of turning over sand only, and had not the opportunity of seeing some of the finer work, it seemed to him that he did not know what was coming. The result was that the boy lost interest. They should let the apprentice see that the foundry trade was really a craft. He himself did not consider that the turner was a craftsman, but the foundryman was an ideal craftsman. With regard to commercial education, he had tried to get someone to take up the commercial aspect in the foundry world, but nobody would help. It seemed to him that the man must study himself—he must take up subjects like bookkeeping. Again, how many foundrymen knew a language apart from their own; for instance, how many knew French? At one foundry he knew there was a clerk who could speak French, who was conducting foundry work at a salary of £1,500 a year. The proprietors were quite willing to employ a foundryman for the job if he could talk French. The clerk referred to was travelling on the Continent. The French language was a universal one, and was a great asset.

MR. A. C. FRANK, speaking with regard to commercial education, said that the ambitious youth in the foundry who wished to get on could very well attend commercial classes. Again, if he could get into a small foundry, where he would rub shoulders more with those in the office, he could learn a lot about such subjects as bookkeeping. Unless he knew something about office routine he would not get farther than the tools, or in charge of those who used the tools. The foundry trade was making rapid strides, more rapid than in any other branch of the engineering trade. Some of the cores he had seen were really works of art, and some of the moulds were such that it seemed a pity to pour metal into them. With regard to boys entering the foundry, there was more enticement to enter some foun-

dries, which were kept in good order, while others were not fit for a boy to enter. This was particularly the case in iron foundries. If a lad was employed all day sprinkling sand, he would naturally object.

THE PRESIDENT, dealing with the question of the opportunities for learning the commercial aspects of the business which exist in smaller foundries, said that he would go further than Mr. Franks, and say that the best place to learn the foundry business was in a small jobbing foundry. In a large factory everything necessary was at hand, but the ingenuity, wit and craftsmanship required in a small foundry was a great help. Whether the proprietor of a small foundry would be prepared to let a boy into his office he did not know.

MR. BARTLETT said that the only way to remove the stigma which was still sticking to the foundrymen was to get the right type of apprentice to enter the shop. It was not a good thing to take the first boy that came along. Before taking fresh boys on he looked round and tried to interest teachers, schoolmasters, etc., in the district, by pointing out the possibilities in the foundry trade, but he did not get much support from them. The universal opinion of parents in better-looking positions was that they would rather have their boys working in an office, possibly for half as much money, because they would look respectable. At one time the workers had no time to educate themselves, but with the eight-hour day there were many opportunities, and it was the boy who would take an interest in education that they wanted in the foundry. The question of interesting the boys in their work lay not so much in the hands of the foremen, but in the hands of the men with whom they worked. If the men would take more interest in the boys they would be better men later on. The question of teaching did not seem to be taken up by either the employers or the workmen. The boys came into the foundry and had to find out for themselves, and this was not the right way. If he saw a boy doing something absolutely wrong he would take the trouble to show him the right way, but, as a rule, that was not done. With regard to the commercial aspect, he did not think the boy in the foundry had an opportunity of learning anything, unless he was in a very small place, and he was not welcome in an office. He was not only dirty, but he was not always wise, and an employer, naturally, did not want a boy to know everything that was being done.

THE PRESIDENT said that those working in the foundry had to make their opportunities, and in this respect theirs was not distinct from any other industry.

MR. BARRATT, speaking of the period between the ages of 14 and 16, when the provisions of the new Education Act come into force, said he presumed that that period would be spent in a trade school. How was it proposed to establish these trade schools? Would there be a trade school as a centre, or one attached to each school, or would the boys go into a school maintained as a workshop, on a competitive system? There was a vast difference between teaching a boy at school and in a workshop. Some years ago he attended an exhibition at a London County Council trade school, where they were moulding some propellers. These would never be moulded by a competitive firm as they were at the London County Council trade school. They were moulded more for show than they were to pour metal into, and if a boy was trained at a training school he would not be properly equipped to enter a foundry, because he would soon become disillusioned, owing to the different environment between the trade school and the conditions of the usual foundry. Some years ago he had had occasion to visit a well-equipped trade school, and he asked how many boys entered the foundry industry. The answer was that not 1 per cent. of them did so, and the reason was that the boys invariably did not like the foundry industry. The boys could not be induced to enter the foundry, because they got information from men already working in the trade and from men in other shops, and when totalling up the experience they gained in this way the foundry was a dead letter.

THE PRESIDENT said that the schools he had in mind were trade schools not working under a competitive system. He did not consider that a boy of 14 should work under competitive conditions. The school he had in mind was one to which a boy could go and see all the various branches of industry and pick out for himself that which he considered was his vocation in life. If the boys were trained properly and were allowed to see some of the interesting sidelines of foundry work he thought more would go in for it. With regard to outside influences, the average foundryman never told anybody to enter his own trade. To his mind the foundry was coming into its own, and he thought that in the not far distant future a boy would be proud to go into the foundry. The boys should be given the opportunity to see things as they really are.

MR. BARTLETT, in discussing the insufficient wages paid to apprentices, said that the earning capacity of a boy depended very much upon the parents. They were very often concerned as to how much he could earn while they had to keep him, and put him into that branch of industry in which he could earn most. His firm were offering a wage of 22s. 9d. per week to boys starting at 14 years of age, but these boys were not indentured. They never thought of putting a boy in simply because he wanted to work; they tried to get a school report, made inquiries as to who his parents were, always saw that he was as respectable as possible, and insisted on the boy having passed the seventh or ex-seventh standard. He did not think it was impossible to get the right type of boy if proper steps were taken; if they waited for the boy to turn up they usually got a type of boy who could not get another job. In answer to the President, Mr. Bartlett said that although there was nothing to prevent the boys from leaving if they wished to, he made a point of lecturing them and impressing upon them that they were bound to stop as a matter of honour, and they were never dismissed if it was possible to keep them.

MR. BENBOW said that one of the greatest difficulties was the fact that for the past six or seven years the boys had been earning a fabulous amount of money, and until this state of affairs came to an end it was a difficult matter to get boys. They were coming along a little better now, however, and every boy who came into his works came on a period of probation for six months (prior to being indentured). So that he was given a fair chance to see if he would like to carry on with the trade, and it could also be seen if he was capable. Apart from that his firm were giving

the boys one day at school free each week, for which they are paid their ordinary wages. But the firm insist upon their attending technical classes on two or three evenings per week. And if they sit for examinations the firm pay the fees.

Mr. A. C. Frank said that he had apparently been misunderstood when he referred to the younger men in a small concern having more opportunity to learn a little of the commercial aspect of the trade than those in a larger concern. The young man in the small foundry would get a chance to know a little about credit notes and despatch notes, and by attending evening classes he could get to know more about the commercial side of the business. These remarks refer to those very few lads who enter the foundry with the determination or desire to fit themselves for some position of authority in the works or sales office.

Mr. H. O. Slater said it would be a very good thing if they could hear the views of all parties and formulate a scheme whereby the boys could be trained at school as well as in the foundry and paid for time spent at school, which could be one or two days a week; it would be expecting too much to ask a lad to attend school after working all day in a foundry. There were comparatively very few men who could afford to keep their children at school until they were 18 years of age. In order that those boys who had attended secondary schools should be able to enter a works as apprentices, he suggested that they should canvass the firms and ask them if they could raise the age limit for entry into apprenticeship, and try to re-institute the apprenticeship system. He thought that the manufacturers were mainly to blame for the dearth of boys in the foundry industry, because they often took them into a foundry and kept them on one particular job, and they did not want them to become confident, self-possessed men able to assert their knowledge. They would not allow a man to say whether a thing was right or wrong. He thought it would be a very good thing if they faced the employers and let them know the object of the Institution.

Mr. A. Willis (Branch Secretary) said that the President had attributed the social rise of the foundryman to the chemist, but he differed from this view. He really thought the credit was due to the Institution of British Foundrymen. At the inception of the Institution there were a few employers, managers and foremen of great foundries who had realised that there were difficulties which they could not fathom, and upon which neither chemists nor anybody could advise them. They, therefore, came to the conclusion that the best thing to do was to form the Institution, so that practical men could get together and discuss the technical and theoretical connection, and he thought that the germ of the idea was that they had not enough knowledge of the practical part of the work, and also that the chemist and metallurgist had never gone into the problems that the founder had to deal with. With regard to trade schools, the difficulty up to now was that they did not get good practical class teaching. The students were taught from a laboratory point of view, and anything to do with metals had been too complicated and too far advanced to be useful. At the inception of the Institution they let in the bottom dog—that is, the moulder. The moulder really had been, as it were, the text-book of the practical foundry industry for many years. When he was a lad there was no text-book where he could find a formula or anything to guide him in anything higher than actual work in the foundry. In chemistry text-books, organic or inorganic, or in courses at the institutes, they all went in for metallurgy which dealt mostly with the production of metals from the ores, and when they wanted to get something in the way of practical understanding of the properties of metals, mixing alloys and making into castings, the thing broke down altogether. It was through the formation of the Institution and the influential men who had entered it at the start in co-operation with some of the greatest chemists, etc., in the country, and by the help and assistance of those who had given lectures all over the country, and the men who had attended them, that really had brought to the knowledge of the engineering trades the importance of the foundry industry. The importance of the foundry industry had to a great extent been discovered through the war. In engineering shops all over the country the practical men in the industry had to be consulted —men who had made a study of metals—in order to meet the specifications of the Government in the making of fuses, shells and so forth, and they had to join hands with the metallurgists and the chemists in order to produce the results the Government required. It was a very difficult matter to turn out castings to satisfy some of the Government inspectors. They had been told that they should study the commercial side of the industry more. He thought, however, that the founder or the manager of a foundry, or the foreman, had a highly scientific, technical job, and if he could produce his castings at a low cost and ensure their being received favourably by the customer it was better to let somebody else look to the commercial side. He did not mean to suggest that he should carry out the manufacture of the castings without paying due regard to the cost, but, so far as the bookkeeping or the selling element was concerned, he thought the foundryman should be left out. The only thing that he thought the manager or foreman should have a hand in was the purchasing of the material. In many cases this was left in the hands of a clerk or some other inexperienced person who knew nothing at all about the properties of the metals or the requirements of the foundry regarding these metals. There should be close co-operation between the office and the foundry, but they were asking too much of the foundryman when they asked him to learn languages, to gain a higher commercial experience, etc. As a boy he was fortunate in working in a small foundry. He certainly learned what the castings were sold at. He made out invoices and kept books for a time, did core making, saw to the fires, learned moulding, and he looked upon the five years he spent there as invaluable to him. He was afraid that if he had had his choice he would have gone to another trade, but he became interested in the foundry through being able to see the process right through. Regarding apprenticeship, he thought that the old-fashioned apprenticeship was best for the foundry trade, because the trade was a craft. It was more than a simple craft that could be taught in a trade school. The old dictum in the moulders' trade was the older the moulder the better the moulder. In many businesses where there was not so much repetition work every job was a fresh problem. Therefore

he thought that they should have a good apprenticeship system, in which a boy should go through the workshop from one branch to the other until he became a qualified craftsman.

THE PRESIDENT remarked that Mr. Willis said he never had the opportunities of getting text-books, etc., in his younger days. That was a disadvantage many of them had suffered, but they had THE FOUNDRY TRADE JOURNAL at the back of them, which contained a great deal of interesting matter. Speaking of the foundryman learning a little of the commercial side of the business, he meant, of course, the foundryman who knew his trade, not only the practical, but from the theoretical aspect, so that he could be of more use to his employer and hope to be an employer himself at some time.

MR. CAROL thought that it was an impossible task to attempt to set up an apprenticeship system, because he did not think that employers would be prepared to pay the high wages which the boys were demanding. Boys in his neighbourhood wanted 23s. 6d. a week to commence. In his firm they usually started boys at this figure, and probably gave them a rough job, and if they had any ability at all they usually started them at the core banks and then went on to moulding.

MR. WILLIS said that the Institution had not taken any part in the discussion of wages, but really the low status of the foundryman in this respect, in his opinion, was due to the low wages paid for a good many years. Through the combination of the trade unions the foundry trade had become a part of the Engineering Federation. That is, they had to be consulted, and their financial status improved with that of the engineering trade. The rise in their financial status was not, in his opinion, adequate to the highly technical and scientific nature of the skill expected from the British foundrymen to-day, and instead of being simply equal to other branches of the engineering trade, in his idea they should be above that, and also very much above receiving the payment of a few half-pence more than the labourer. That was really what this Institution was working for, and once the importance of the skilled foundryman was realised by the employer he would be glad to pay the extra money. Members of the Institution were going all over the country to take jobs as foremen and managers of foundries, and it seemed to him that in time to come they might look upon it to provide the men for the highest positions in the foundries all over the country. In conclusion, Mr. Willis proposed a vote of thanks to the President for his address.

The vote of thanks was seconded by Mr. Barratt, and carried with acclamation.

THE PRESIDENT, in replying, said he hoped that during his year of office much useful work would be done, and that he looked forward to the time when the Institution would be something really worth while.

LANCASHIRE BRANCH.

The proceedings of the Lancashire Branch for the session 1920-1921 were opened by Mr. W. H. Meadowcroft (Branch President) at the Manchester College of Technology, on Saturday, October 2.

PRESIDENTIAL ADDRESS.

The Welfare of the Craft.

MR. MEADOWCROFT, in delivering his presidential address, expressed a wish to see the foundry industry raised to a more dignified position than it had occupied in the past, and it was for that reason that he had always devoted, and should continue to devote, his best efforts in forwarding the interests of the Institute of British Foundrymen. The past year had been a very trying one for everyone connected with the trade. Since 1918 they had been up against the task of reverting to normal conditions, and had been fondly hoping for a speedy return to pre-war results, but those hopes had not materialised owing to a variety of causes. When this country was plunged into the great world conflict all energies were devoted to the task of defending the Empire and maintaining industrial activity. Under the stress of a common danger men were drawn together, and everyone showed a desire to help. This was particularly noticeable in the foundry world; the old and conservative idea of "leave it to me" was broken down, and foundrymen generally showed a keen desire to confer with their fellow craftsmen on the tasks and problems which the pressing need for exceptional production had compelled them to tackle. The work of solving these problems was greatly facilitated by this new co-operation and the exchange of ideas and experiences. It was a very desirable state of affairs, and it was as vitally necessary to-day as it was then if the present status of the foundry was to be improved. They must continue to have faith in each other—foundryman, engineer, designer, and scientist would all have to work together to the common end of uplifting the craft from the dire straits into which rule-of-thumb methods had placed it, and they must see that it took its position as a true craft. As things now stood, unfortunately, one could seem to find evidence of a falling away from the spirit of mutual helpfulness which had so much assisted them during the past few years, but still he felt they would never go back again to some of the bad old days of the industry. He referred to those days when the foundry stood in a position of isolation from all outside influence, when engineers and designers looked upon the moulding shop as a haunt of mystery, a place of weird methods and uncertain results. Those days were gone, and it was incumbent upon those who represented the trade in all its varied forms to see that they never returned.

The result of the past neglect of the foundry by engineers had become lamentably apparent in the past year. Great engineering works were carrying on in a lop-sided fashion, their machinery and plant being partially stopped, or at the most working on a hand-to-mouth basis, owing to the inadequate supplies of castings. Of course, foundrymen were in part to blame for this, but the major portion of the criticism must be directed at those people who organised and developed huge works, perfecting every detail save one—the foundry. It was foretold many times by the thinking men in the engineering and foundry trades that this state of affairs would come about, but the buyers of castings, dealing in a market where jobbing foundries were in keen competition, did not heed their warnings. All this brought them to one thing: they were faced with a demand for castings which they could not meet at present. What they had to do, therefore, was to produce more. They did not look at the problem from the point of view of the economist, but from the standpoint of practical foundrymen. The production of good castings was their object, but how to

achieve that object was the duty of their Institution to consider.

First of all they must consider the greatest factor in the securing of good results, *i.e.*, the moulder. Nowadays it was not the fashion for a workman to appear to take any interest in his employment except as a means for providing his daily bread. This must be altered. They would have to give the moulder a higher conception of his daily work than this. Could they teach him to take a real and whole-hearted interest in the results of his toil? In his (the speaker's) opinion this could be done, but it would require much thought and trouble to bring it about. It had been found by individuals and firms who had pursued this plan that short talks on a firm's products were a source of great interest to the actual producers of the castings. A product with a reputation, whether it be an unfinished casting or a finished machine, often inspired in men that pride in their work which gave such good results. Men would work together in a harmonious manner much better if they could see that they were achieving some effective and tangible result. He must not, however, upon that occasion go into intimate details of how this question of increased output might be solved. It was a subject of vast proportions, and its treatment would need a separate paper; but it was such a pressing subject that one must needs touch upon it in any reference to conditions in the foundry.

With reference to themselves, he was more than pleased to be able to say that the position of their Institution in the engineering world was steadily advancing. As their aims and objects became better known they hoped for greater financial help from those firms who profited by the work of the Institution. The new rule which allowed firms to become members upon an annual payment of five guineas would, they hoped, help them to increase the sphere of their usefulness. They were justified in expecting a wide response to their invitation to engineering firms to come in and help them in doing the work of solving those problems which affected both foundryman and engineer alike. The practice of the Institution of having discussions upon problems submitted by their members and friends had been the means of giving much valuable information, and this practice was capable of great development.

There was also the ever-recurring question of education. He thought it would help matters from a foundry point of view if their members individually took some interest in the provisions of special classes for foundry apprentices in their own districts. If they were to get the right type of boy in their shops, they must try and make the foundry trade appeal to boys. When there was a desire upon the part of boys to enter the foundry, they would have no difficulty in choosing those who would be the most suitable from a temperamental and physical standpoint, and when they had got the right material, they must see that it was trained in the right way. At present the majority of foundries were, to the average boy, far from inviting, and they thus lost the opportunity to secure for themselves and their successors the very men who would raise the status of the work, and who would help to solve the difficulties which beset them. It was not that a foundry was necessarily a drab and dirty place, though this was true of most. A little care and forethought by the management, and their shops could be made much more pleasing to look at and to work in. For instance, take the ordinary core-drying stove, which filled the place with smoke and fumes, and at times rendered the atmosphere unfit to breathe. This could be remedied quite easily by the adoption of the modern system of core-drying, in which the full value of every ounce of fuel was obtained without having the drying chamber filled with the products of combustion. Putting on one side any hygienic consideration, sheer economy demanded the abolition of the ancient method of core-drying, and if they were to take into consideration that a modern stove was light and clean and free from noxious fumes, the arguments in its favour were overwhelming. Anything they could do in this direction to make the foundry a more comfortable and healthy place to work in would most certainly have good results. The workmen would appreciate the fact that a genuine attempt was being made to brighten their conditions of labour, and when it was realised that their employers were taking pains to ensure better working conditions, it would help to break down that suspicion which was the one great stumbling-block to harmonious relations.

The present session promised to be a very busy one. The next Annual Conference of the Institution would be held in Manchester, and one of their members was to be the next President, and they had every prospect of making their Branch the largest and most active one in the country. He sincerely hoped every member would do his utmost to further this prospect.

Discussion.

Mr. W. H. Cook, in proposing a vote of thanks to the President for his address, referred to the question of education. It appeared to him that they were more and more trying to do without the skilled man. He thought the foundry of the future would be one of machines, and that this might militate against the prospect of obtaining skilled men in their works. Apparently they were all trying to make labourers into moulders. In one place with which he was connected they had had, since the moulders' strike, six fitters doing nothing but plating. They had put down eight machines. He considered that a plate moulder was as skilled as an ordinary moulder, and was infinitely more valuable to people who had to produce castings. He thought they would all agree with him that they did not pay their foremen enough, and the same remark also applied to those whom they called their unskilled men.

Mr. Sam Roe (ex-President) seconded the vote of thanks, and endorsed the remarks made by Mr. Cook.

The vote of thanks was carried unanimously.

New Core Stove.

The President then described the installation of a new core stove at a works in which he was interested, and which was a great improvement upon the old-fashioned system. The alteration was easily effected, and, instead of having something which could reasonably be compared to the "Black Hole of Calcutta," they had now a beautifully whitewashed structure, which could almost be said to be like a greenhouse. The heat was well maintained, and the atmosphere in the foundry was quite pure.

Less heat was required to dry the cores than in the case of the ordinary foundry. The stove was easily fired, and only required attention three times a day. It attained a temperature of about 410 deg. The stove was about 34 ft. long, 14 ft. wide, and 8 ft. high.

MR. HOGG raised the question of the suitability of gas-fired stoves, and there appeared to be divergent views as to their efficient working.

MR. W. H. COOK said that it was largely a question of the method of operation. He had found the trouble with most core ovens was that there was insufficient ventilation.

MR. R. A. MILES stated that he had seen the stove referred to by the President, and he thought it was the best type of stove he had ever seen. He also referred to a form of vacuum drying-stove, worked on somewhat similar lines, but which he thought at present was not a commercial proposition as applied to foundry practice. The air was drawn out by a vacuum or by a fan.

MR. W. H. COOK suggested that a paper might be read dealing with the subject of core ovens, and this was approved.

Annual Conference, 1921.

A discussion took place with respect to the arrangements to be made respecting the next Annual Conference, and in the result a special sub-committee was appointed to go fully into the matter and report at a later date

NEWCASTLE BRANCH.

Annual Meeting.

The annual meeting of the Newcastle and District Branch of the Institution of British Foundrymen was held on Saturday, September 25, 1920, in the Lecture Theatre of the Mining Institute, Newcastle-on-Tyne. The retiring President, Mr Edward Smith, occupied the chair at the commencement.

The annual report of the Council stated :—

Eight meetings have been held, and the attendances have shown a marked improvement on previous years. On several occasions some 85 to 95 members and visitors were present. This is very encouraging, and indicates a more lively interest in the work of the Branch generally.

During the past session we have had some excellent papers and discussions on subjects of paramount importance to the foundry industry generally. The "Open Discussion" meetings were very well attended, due, undoubtedly, to the important subjects dealt with. It was a notable feature of these discussions that a larger number of members took part in them, and many "new" aspects of "old" questions were introduced.

The membership is increasing satisfactorily, and the Council would like to see further progress in this direction. This can easily be accomplished by each member bringing in at least one new candidate. The present total is as follows:—

	1920.	1919.	1918.
Members	60	50	37
Associate Members ...	69	69	64
Associates	34	34	28
	163	153	129

In order to make progress, and to attain a local representative membership for the North-East Coast district, it is incumbent upon all members to make special efforts to increase our numbers. Employers should encourage their men to join; members who are not employers should urge their co-workers to join, by explaining to them the aims and advantages of our Institution. Taking the district in our charge, we should have no less than 600 members, and it is the desire of the Council, and certainly of every active member, that we make greater efforts for an increased membership.

Our financial position shows progress. We remitted to headquarters for 1919 the sum of £82 14s. 6d., subscriptions received, as against £80 2s. 6d. for the previous year. The Branch expenses were £36 17s. 2d.

Mr. Mayer is investing a sum of money to provide each year a gold and a silver medal for foundry apprentices who attend classes and pass with honours in certain prescribed courses. Newcastle and Glasgow Branch members will participate each alternate year.

The John Surtees Memorial Fund.

THE PRESIDENT moved the adoption of the report, and, adverting to the Surtees Memorial, said, unfortunately, the war intervened when they were trying to arouse interest in that fund, but they found it very hard indeed at that time to arouse interest in an object that was dead. Unfortunately, nobody personally knew the late Mr. Surtees. Mr. W. Mayer had kindly given £25 to start the fund, but there was not a large response from the members. Mr. Mayer, therefore, called some of them together when they were at Loch Lomond on August 26 last, and stated he was determined to perpetuate Mr. Surtees' memory in some way. He therefore proposed to invest a sum of money, the interest of which would be used for the benefit of the Scottish Association and the Newcastle Branch. There would be a competition of some kind, for which gold and silver medals would be offered along with prizes of books. He thought this was a very good suggestion on the part of Mr. Mayer.

The report was unanimously adopted.

Election of Officers.

The election of officers for the ensuing year resulted as follows:—President, Mr. George Vardy; Senior Vice-President, Mr. R. O. Patterson; Junior Vice-President, Mr. H. J. Young; Hon. Secretary, Mr. H. A. J. Rang; Council, Messrs. A. Morris, J. N. Simm, J. J. Collin, James Smith, and H. J. Young. Votes of thanks were accorded the retiring officers.

THE PRESIDENT, in responding, said he had had a very happy year of office, and anything he had been able to do for the Branch had been a labour of love. They were very fortunate to have such a staff of officials.

The Presidential Address.

MR. VARDY, the newly-elected President, then delivered his presidential address, in the course of which he said:—

This is a very critical period in the industrial history of the world—perhaps the most critical that has ever occurred. A time of great difficulty has existed since the Armistice, and this has undoubtedly been exploited by certain people in all

countries. Our country up to the present has not experienced such an upheaval as several others, but, as we all know, we have had great difficulties to contend with. There has been a tendency to interpret the Utopia which, during the war, was promised so often and by so many as the result of the war, as a period of almost unlimited wages, which would be rendered possible by the *apparent* great prosperity of industry during the last five years. This has resulted generally in the country resting on its oars, and, instead of the increased production which is necessary, we are faced in all industries with a reduction in output.

What is really required is a largely-increased output, not only for the purpose of providing wages, but, over and above this, the whole of our war wastage is yet to be made good. During the war we were living on our reserves, and these have now virtually disappeared. The general standard of living has been raised, and rightly so; but with this the standard of extravagance, if one may use the expression, has also been increased. The whole country during the war lived in an atmosphere of apparent luxury, which has now become a habit, and we have to find a means of making the public and labour generally realise the position, with the alternative of industrial bankruptcy. We would all like to see labour on as high a level as possible, and in the development of labour, both industrially and politically, is probably our greatest hope of a permanent improvement of conditions in this country. Incidentally, it appears to an outside observer that the greatest danger to this development comes not from the much-maligned reactionary party, but from the extremists within labour's own ranks. One is reminded of the analogy of Germany. Before the war her industrial progress was so rapid that, had she been content with that progress, another 10 years might have seen her in a position of almost complete industrial supremacy in the world. Instead, she allowed her extremists to adopt methods of force to obtain this desired supremacy, and the result has been a complete collapse. The extremists associated with labour are too often confused in the public mind with labour itself. The interests of the whole country, as well as those of labour itself, will best be served by Labour's rapid political development, and such would undoubtedly be the death-blow to the adherents of red revolution.

We all know these facts and probably realise their significance, and our difficulty begins when we try to find the antidote. In my own opinion, our politicians have left this most important matter very severely alone. Had the question been one of Tariff Reform, or other questions of doubtful importance, probably each of our street corners for months past would have had an orator putting the case to the people, and endeavouring to make them understand, but apparently because the life of the nation is at stake, nothing very much of an educational character has been attempted. While we have been frittering away the time, France and Belgium have been steadily improving their position. Working hard, steadily and fairly long hours, they have—and Belgium particularly has—to a very great extent retrieved their position, notwithstanding the devastated condition of their countries, and the state of exchange being so much against them. They had the advantage of realising that there had been a war, and had not suffered from the demoralising effect of the conditions which held in this country.

As regards engineering works, we are now being asked to send them inquiries for all classes of work, and recently we were invited by Belgian firms for them to be allowed to quote for castings up to 1,200 tons per week. We all know too well the state of affairs which has existed in this country regarding getting castings ever since the moulders' strike, and to find that British firms have to go abroad to buy what, with normal working, could quite well be produced at home, is very alarming. In my opinion, the only way to overcome this great and serious difficulty is first to have the workers thoroughly educated as to the real position, and, secondly, for employers to do their very best to put their works in a condition to obtain as much output per man as possible. This does not mean sweating the worker, but means giving him such facilities and assistance as will enable him to do his best both as to output and quality of work and with pleasurable and healthy surroundings.

Educational Scheme.

With reference to educating workmen, this has been tackled by dealing with the apprentices and young men, by giving them such training as will enable them to become good and sensible citizens. This we are attempting to do in the works with which I am associated by means of a well-developed welfare scheme which looks after the health and training of the whole of our apprentices. The scheme is fairly comprehensive, and covers a workshop where certain types of apprentices are kept by themselves for as long as two years doing work entirely on their own and finishing it. We find in this workshop that the lads take a much greater interest in the work they are doing and greater pride in it, because they are doing it themselves. The work on which they are engaged is really useful and productive, and that makes it much more interesting for them. The workshop is entirely self-contained; they have their own timekeeper, buy their own material, and estimate for the work, both for the rest of the yard and outsiders.

In connection with this workshop there is a school. This comprises two departments, one thoroughly technical and the other partially technical. The technical school is controlled by a competent draughtsman, and deals mainly with engineering and shipbuilding in its various phases, and boys are taken in from 14 to 16 years of age. The course extends over two years, and the boys attend week and week about. We pay during the week the boys are at school pre-war rates. The other school is composed of boys from 14 to 20; these are perhaps more casual, and are drawn from the apprentices' training shed. These boys are given one day per week at school. The subjects taken are English, mathematics, industrial geography and history, citizenship, economics, thrift and temperance, together with hygiene and general reading. Thus their education is not that which solely makes them competent workmen, but raises them to a state of better citizenship. Since a healthy body is essential to a healthy mind, the physical training is not neglected. Proper courses in physical culture and physical development are carried out by a competent Army instructor, who runs evening classes. Competition in these schemes is naturally very great, creating

alertness and tending to make the boys appreciate what is being done for them.

Associated with the welfare work is an institute which has a thoroughly equipped reading-room and library, billiards and games room, and a canteen. The institute is run on broad lines, and we hold occasional dances. Lectures, too, both lantern and cinema, are occasionally given, with the intention of their being instructive and educative, and likewise a tinge of amusement must necessarily be associated.

Since the number of apprentices is so large, naturally a great amount of catering has to be done to appease and satisfy the inner man. Cravings for pleasure of minds so varied have induced those associated with the work to arrange such programmes of music and singing, both classical and sentimental, as well as humorous, to create interest and likewise develop a liking for the higher element in life. Supervision of such work demands great attention, and one is pleased to state that not only the management, but likewise the foremen and workmen themselves are voluntarily associating themselves with this work, to assist the firm in turning out boys who will eventually become the prominent citizens of our towns and communities. Since the scheme is practically in its infancy, one dare scarcely say what the eventual results will be of so great a work. We are glad to state that the boys are very keen themselves, and are daily seeking advice as to the means of furthering their education and bettering their social position.

We have instituted for the last four years a camp at the seaside, where the apprentices are at liberty to go at a charge of 5s. per week, for a period of one week. This has been greatly appreciated, and this year no fewer than about 200 boys took advantage of it. In addition to the above, to look after the well-being and training of the apprentices who have to leave their homes in order to come here, we have instituted a large house at the coast where these boys are boarded at cost price, and where they have many of the advantages of a good home. A good study has been provided, and also a billiard room, and there is a games park within a hundred yards of the house.

We trust that in time we shall produce good men, who will be outside the influence of such extremists as are at present creating so much difficulty and threaten such calamities.

In conclusion, I only wish to say that, in my opinion, Labour, if left alone to natural development, will rise above present difficulties, and take a responsible and capable share in the development of industry and of the nation's welfare.

Discussion.

Mr. Matthew Gallon moved a vote of thanks to the President for his address. He said it was a most practical paper, and might have greater results than even the President himself anticipated. During the war they had simply been taking in each other's washing, and it was obvious that they could not continue long on that basis. That was not trade. We must sell more work to others than others sold to us. If we did not do that, then England was surely going backward instead of forward. It was up to Labour to dignify itself. At the present time Labour seemed to see only one side of the mountain; and the difference between the clever man and the ordinary man was that the former saw all round the mountain.

He (the speaker) was very much interested in the welfare-training scheme which the President had described. It was a fine scheme, and he hoped the small employers would combine and do all they could to further such schemes. He intended to take hold of the idea, and try and get something done with it.

Mr. E. Smith said he was very much in sympathy with the welfare scheme, but he thought that, whilst such schemes could be worked advantageously in a big firm, it would be found to be very difficult to get them to work in a small firm. In the foundry trade in South Shields they were in the awkward position of not being able to get boys. There did not seem to be sufficient attractions about the foundry. He was afraid that an engineer was looked upon as being much superior; the foundryman was looked down upon, although such should not be the case. Mr. Smith went on to emphasise the great need there was for increased production; that was the most important thing if we were, as a country, going to keep our premier position. We must have a considerable increase in production, otherwise we should go under. He had been astonished to read in The Foundry Trade Journal of the large number of new patents which had been applied for, and still more astonished to see that so many of them were of German origin. There was no doubt Germany was coming in again, because our men were not producing enough, and there was evidence that she would forge ahead and be just as severe a competitor as she was before the war. He had recently been on a visit to France and Belgium, and had been deeply impressed by the incessant rap of the trowel night and day; both those countries were determined to get their trade back to its pre-war level. If our men did not produce more, then we should not regain the premier position which we formerly held.

The vote was carried by acclamation, and the President suitably replied.

SCOTTISH BRANCH.

The first meeting of the Scottish Branch of the Institute of British Foundrymen was held at Glasgow on October 9. Mr. A. Fraser (Branch-President) in the chair.

The President, in his opening remarks, referred to the retirement of Mr. MacFarlane from the secretariat of the Branch. Much of the success which had attended the Scottish Branch had been due chiefly to his untiring efforts. Mr. MacFarlane, during his term of office, had conducted the affairs of the Branch in a most efficient manner, and he wished to assure him that his services had been appreciated to the highest degree.

Presidential Address.

Mr. Fraser then proceeded to deliver his Presidential address on the subject of "Production."

His reason for selecting that subject as the theme of his address was that production was a matter of general interest, and one which was being largely discussed at the present time.

When discussing the subject of production, it was very difficult to make it clear to the ordinary individual how an increase in production would eventually be beneficial to himself and indirectly to the nation. In the early days when man con-

sumed all he produced, increased production appealed to him, but the system of trading had got so complicated that it was difficult to demonstrate the immediate effect of increased production. In a manufacturing country such as ours, it was absolutely necessary that we should have a certain amount of production in excess of our immediate wants, in order to pay for the large amount of food, etc., which we import for foreign countries. Increased production was necessary in all our industries if we were to maintain a favourable position in the world's trade, and the question which we had got to face was, how was this to be done, and accomplished in a way which would meet with the general acceptance of the whole community.

The speaker referred to a system of co-operative production which the firm of Messrs. Priestman Brothers, of Hull, have had in operation for the last 2½ years, and which had met with the general acceptance of all parties concerned in the experiment. The scheme was based on the principle that, if a number of men on ordinary day rates of pay in a given time were accustomed to produce a certain quantity—measured by value—of finished work, called the "standard," then if, without adding to the number of men employed or the hours worked, by greater individual effort, the output is increased, the day rate of wage could be supplemented by a percentage equivalent to that by which the actual output exceeded the standard. The system was described as the application of teamwork to industry. To the many branches of foundry work which are not suitable to the introduction of piecework, this scheme might be adopted.

Explaining the system in detail, Mr. Fraser assumed a business with an average turnover of £100,000 in a year, with an assumed trade account as follows:—

	£
Materials	43,000
Salaries and wages	40,000
On-cost	7,000
Transport	2,000
Profit	8,000
	£100,000

If such a firm adopted the Priestman co-operative production scheme, but with value substituted for tonnage, and the turnover increased 25 per cent., the on-cost charge would remain stationary, and the charge against materials and transport would increase by 25 per cent. The salaries of every employee, from the manager to the youngest apprentice, would be increased by 25 per cent; the margin of profit would also show a marked increase, and the new trade accounts would therefore read as follows:—

	£
Materials	53,750
Salaries and wages	50,000
On-cost	7,000
Transport	2,500
Profit	11,750
	£125,000

THE PRESIDENT remarked that the most important points in the scheme were that every employee was interested in the amount of production, and that the scheme accepted the present view of trade unionists that the proper method of payment was a standard wage for a standard day. All the employees were paid days' rates, and receive as a minimum the full rates, plus any bonus, or other additions which might be part of the agreed union rate of payment for the class of labour for the district.

A balance was declared monthly, and the increases, if any, were applied the month following that in which they were earned. Thus, if the output for January was 50 per cent. above the standard, the wages for February were increased accordingly on what was earned in January. It should also be noted that no information, which was the private property of the employers, was disclosed to the workers; the agreed standard was given in terms of value; the books showing the monthly deliveries were open to the inspection of the shop's committee, and the shop's committee accepted the figures as correct before the monthly returns were posted in the works.

The address was interesting and instructive, and at the close the President was accorded, on the motion of Mr. H. Hodgart, a hearty vote of thanks.

According to the "Industrial League and Council Journal," for November, it has been decided to make their publication the medium for reporting what each and all of the joint industrial councils are doing. In this direction the Journal will undoubtedly provide long felt want. Up to the present time, excepting through the medium of official channels, only scrappy reports of the activities of the various Whitley Councils have been available through the Press, with the result that the abundance of good work which Whitley Councils have accomplished, has been allowed to pass unnoticed, much to the detriment of the development of the scheme.

NORTHAMPTON POLYTECHNIC INSTITUTE, St. John Street, Clerkenwell, London, E.C.1, held the annual prize distribution and students' conversazione on Friday, December 3, 1920. Dr. Sydney Russell Wells, Vice-Chancellor of the University of London, distributed the prizes and certificates. The conversazione for members and students was continued on Saturday, December 4, when the building was thrown open to the whole of the members and students and their friends.

CENTRIFUGAL CASTINGS.—During recent years considerable progress has been made in the production of iron castings of cylindrical forms by spinning or rotating the molten cast-iron in suitably designed machines. Hitherto the more extensive developments in this type of casting process have occurred in America. We are informed on reliable authority that a British machine has been designed for the production of large cylindrical castings by this rotary or centrifugal process direct in a machinable grey iron. Patents have been applied for, and a company is at present under formation with a view to operating this machine for the production of large engine cylinder liners and pipes.

CLAY USED IN FOUNDRIES AND STEEL PLANTS.—Figures compiled by the United States Geological Survey state that 28 per cent. of the clay consumed in the United States in 1918 was used by foundries and steelworks for converter and cupola linings and similar purposes. Out of a total consumption of 2,976,361 tons of clay, 834,789 tons were consumed in this way. The value is not given for the foundry steelworks' consumption, but 809,562 tons were placed under the head of fireclay, 24,931 tons as miscellaneous clay, 290 tons as paper clay, and six tons as ship clay. The total consumption of clay for refractory purposes in 1918 was 1,698,674 tons, or 57 per cent. of the total used.

Effect of Zirconium in Cast Iron.*

By Dr. Richard Moldenke.

To the list of deoxidisers useful for the purification of cast iron there has been added another ferro-alloy, that of zirconium. As the list of elements ordinarily in or added to cast iron grows larger, a more thorough understanding of the functions of each one of them, particularly those more rarely met with, becomes of increasing importance. We are all familiar with the action of silicon, carbon, phosphorus, manganese, and sulphur, but know very little about the special effects of vanadium, titanium, cerium, copper, nickel, chromium, etc. Year by year more of the rare elements come into daily use, and as they become more reasonable in price through quantity production, the iron industry experiences a corresponding expansion into new fields of usefulness.

Two Groups of Elements.

For cast iron the elements involved seem to be divided into two groups. The first is made up of those not readily removed by oxidation in ordinary good foundry melting practice. The second consists of the elements readily oxidised under conditions involving the presence of oxygen in the molten metal. The two groups shade into each other to some extent, depending upon the degree of skill possessed by the foundryman in handling his cupola or furnace.

The above will be better understood when such elements as sulphur and phosphorus are considered. Both are increased in melting practice by concentration, as they are not oxidised out. Only the action of a basic hearth in open-hearth or electric furnace practice will reduce these elements in quantity, and only through chemical reactions of a more or less complicated nature. On the other hand, it is known that silicon and manganese undergo definite losses in the melting operation, and mixtures are made up with this situation in view. The behaviour of carbon and iron itself is less certain. Both oxidise under conditions of high heat and the absence of a sufficiency of manganese and silicon to protect them. Most foundrymen have seen the brown smoke emanating from a cupola indicating a low bed and burned iron, when the silicon of the mixture was below 1 per cent. and manganese nearly all gone. In air furnace practice the reduction of carbon is well known, and in long heats there is enough iron oxide in the bath to yield defective castings.

Grading Elements as to Ease in Oxidising.

For the group of the less easily oxidised elements in cast iron, where melting is carried on under the best possible conditions of air supply to the fuel to prevent undue oxidation, the following list may serve. It is thought that the order given may be that of the most stable first, and so on to the middle ground. This order may be phosphorus, sulphur, iron, copper, nickel, tungsten, molybdenum, and carbon. Then from carbon as ready to be oxidised or remain unaffected, depending upon the care taken in melting in cupola or furnace, the order of the elements readily oxidised may be carbon, chromium, zirconium, silicon, manganese, vanadium, aluminium, magnesium, titanium, and cerium. The last-named is probably the one most easily oxidised.

The order above given is practically guessed at, as there is no definite information available on the subject. The writer has an intuitive feeling that it is so from the practical observations made when handling the elements in question in their ferro-alloys. It would be interesting to subject irons alloyed with all of these elements to a very slow oxidising atmosphere while in the molten state, and make continued analyses to observe the rate of elimination of each as the test progressed. This should give the order of removal, and by inference the degree of efficacy for purposes of deoxidation in cast iron.

From the many tests made by the author of deoxidisers of cast iron, it seems that the first effect is the removal of oxygen present in combination with the iron. This eliminates just the amount of the element in question necessary for that laudable purpose. If the alloy added brings in more than enough for this deoxidation, the balance of the element remains in the cast iron and exerts its particular function upon the properties of the casting. Thus, the addition of, say, 0.1 per cent. titanium may remove all the oxygen present in a ladle of molten iron and yield results that are practically as good as if 0.2 per cent. titanium had been used. It is the removal of oxygen—the weakening factor in the molten metal—that permits it to come out with its natural strength due to its composition. It seems as if the crystals adhere more firmly and are given the chance they should have for strength due to a good analysis. If these crystals are of finer quality as the result of added nickel or molybdenum, and if the graphite crystals are small and not too large in number, the product should be a pretty high-class metal. Many claims are made for vanadium and other of the rare elements for cast iron, and doubtless there is much in the subject. Fundamentally, however, the less oxygen present in the metal before the ferro-alloy addition, the more characteristic the effect. Hence the soundness of the policy of devoting every attention to good melting practice so that but little of an expensive alloy need be added to attain a desired effect.

Effect of the Temperature.

One of the difficulties found with the deoxidation of cast iron is the degree of heat involved. It is well known that the hotter the metal the better the effect of manganese added to heats with high steel percentages. Indeed to get a high steel scrap heat safe for pouring moulds it is necessary to use a good fuel percentage. The higher actual temperature of the molten metal resulting promotes the union of oxygen and manganese, and the result is a casting free from blowholes. With ordinary cast iron the added manganese, instead of going into the slag, will be found in the metal; possibly partly in combination with sulphur, but having exerted little or no deoxidising effect. The temperature was not high enough for the reaction.

The consequence of the above is that such metals as aluminium, cerium and magnesium are easily taken up in molten cast iron, whereas titanium and zirconium take more time and heat for the best results.

Large Zirconium Percentage Chills.

In making tests with ferro-zirconium an alloy containing 30.6 per cent. zirconium was used. It was noticed that for the smaller percentages the metal behaved nicely in melting and indicated a purifying action, for the slag came up and collected for easy removal. The larger percentages gave more trouble and chilled the metal considerably so that it was difficut to pour successfully. Unquestionably the alloy will do better service in steel than in cast iron.

Two sets of transverse tests were made. One with a grey iron mixture and the other with car wheel scrap thus obtaining results for grey and for white iron.

Gray Iron Mixture.

Pig 60 per cent. and grey scrap 40 per cent. Average of three bars each.

Breaking str ength in lbs.	Deflection in inches.	Zirconium added. Per cent.
2,700	0.10	None
2,920	0.11	0.05
2,900	0.11	0.10
3,050	0.11	0.15

* From a Paper presented at the Annual Convention of the American Foundrymen's Association in Columbus, Ohio, Oct. 5.

XUM

White Iron Mixture.

Scrap car wheels, 60 per cent.; white iron scrap, 40 per cent. Average of three bars each.

Breaking strength in lbs.	Deflection in inches.	Zirconium added. Per cent.
2,640	0.10	None
2,790	0.10	0.05
2,880	0.11	0.10
2,940	0.11	0.15

As the usual element addition for deoxidation purposes is 0.10 per cent. it will be noticed that the strength increase is 6 and 9 per cent. respectively. Undoubtedly where large steel scrap percentages are used, this increase will be greater, as the oxidation will have been more serious and the temperature of the molten metal higher, making for a better reaction. Further tests in this direction would seem advisable, for the world's supply of zirconium is quite extensive, and it should be converted to the ferro-alloy as cheaply as titanium.

The above data are given at this time in order that those who are interested may be advised. The tests were made over a year ago.

Refractories for Electric Furnaces.

An interesting symposium on refractories for electric furnaces was recently held by the Electric Furnace Association in Columbus, Ohio (U.S.A.).

A contribution from the Foote Mineral Company outlined the requirements for electric-furnace refractories, noting first that refining furnaces, handling metal and corrosive slag at temperatures limited only by the melting point of the furnace itself, have about reached the limit of their possible development. A new, cheap, dependable refractory with a melting point higher than 1,750 deg. C. is now required, a substance which (1) is highly resistant to sudden temperature variation so as to permit intermittent operation, (2) which has been calcined at electric-furnace temperature, and (3) which, therefore, may possess reasonable constancy of volume. It must resist the scour of slag —or if a roof brick, must withstand the action of fume, hot gases and splatters of liquid. It must be a poor conductor of electricity, else leakage of current may be serious. Lastly, it must have sufficient strength at high temperatures so that arches and side walls may hold up.

Manifestly none of our present refractories possesses all these properties simultaneously, as pointed out by several speakers. Fireclay bricks are in widest use in the general metallurgical industry, and many electric-furnace sidewalls are built up with them, but unless the walls are very thin and radiate heat very rapidly, or are water-cooled, the inner surfaces melt down quickly, or soften and absorb quantities of slag and metal from the bath. Silica bricks have given best service in roof arches. Silica bricks melt at about the same temperature as fireclay, but retain their shape and much of their strength to a high temperature. On the other hand, they suffer wide variation in size if not properly burned, and in any case must be heated or cooled at a low rate. Calcined dolomite, although cheap, air slakes readily, consequently its use is confined to making tamped furnace bottoms and for patching.

Magnesite bricks appear to be about the best and most usable of our refractories. While MgO is reduced by carbon at 1,800 deg. C., at lower temperatures it withstands corrosion from most melts, fireclay and water vapour being its two greatest enemies. For best results its lime content should be low, and its tendency to spall may be successfully combated by keeping moisture away and preventing strong temperature changes. High-lime magnesite or magnesite with 10 to 12 per cent. slag admixture is often used for basic furnace bottoms. Mr. Rockwell called attention to the successful use of steel-clad magnesite blocks for bottoms, and particularly in panels built in sidewalls at hot spots near electrodes. A soft-steel box of brick size, with one end missing, is rammed hard with ground dead-burned magnesite. These are not burned, but after drying are laid as headers; upon heating, the iron case melts and a "jointless" surface results which by virtue of its manufacture is more porous than the pressed burned brick, and will stand more rapid temperature changes with less danger of spalling. An instance was cited of a furnace manufacturing chromium-vanadium steel. Whereas thirty heats were the best record on a brick lining, 111 heats were procured from the tamped-iron blocks.

Chromite bricks have also been of unsatisfactory quality for many years. Local ores contain only 30 to 40 per cent. Cr_2O_3, and bricks made of them fail at low temperature. Meantime open-hearth furnacemen have discovered that a layer of chromite is not necessary to separate magnesite from silica brick, consequently their greatest use has been lost. The bricks themselves are difficult to make on account of lack of a good bonding substance, and they have a high thermal conductivity. On account of their resistance to either acid or basic baths, however, good chromite bricks might be utilised for several courses in sidewalls, near the slag line.

Bauxite is favoured as a lining for the hot zones of cement kilns. Other metallurgical uses have not been so successful. As a brick it is difficult to make because of the lack of a desirable binder; it shrinks continuously under heating unless the raw material has been calcined and the brick burned at the most extreme temperatures. After such treatment successful basic bottoms of bauxite have been reported analysing as high as 15 per cent. SiO_2, although 5 per cent. would have been a much safer figure. Even fused alumina bricks cannot be used in furnace roofs, since they react readily with lime vapours.

Alundum and carborundum have been under examination as furnace refractories for some time. Despite their cost their use may easily prove economical; particularly has this been demonstrated when used as door jambs. Carbon, either amorphous or graphitised, also has special applications in furnace bottoms.

Carborundum as a refractory was discussed at length by Dr. M. L. Hartman. Four types are now on the market: (*a*) Recrystallised carborundum, which are shapes passed through the electric furnace the second time, the bond consisting of intergrown crystals; (*b*) three kinds of bonded carborundum, shapes composed of small crystals bonded with certain refractory mixtures; (*c*) various cements for moulding shapes directly in furnaces and for patching, consisting of carborundum with different bonding materials; and (*d*) firesand, a furnace by-product consisting principally of silicon carbide and partially reduced oxycarbides, suitable for rammed-up linings. From these four types a wide variation in refractories can be obtained. In general, however, while carborundum has a high decomposition temperature, it begins to dissociate appreciably under oxidising conditions at about 1,500 deg. C., and under reducing conditions at 1,700 deg. C. Iron, steels, and their ordinary slags also decompose carborundum. It has no softening or transition temperature short of decomposition; its thermal conductivity is high, its coefficient of expansion is low, it resists non-ferrous metals except lead, and it is extremely hard and durable. A bonded variety is made with good electric resistivity at high temperatures.

The Baily furnace may have the trough containing the carbon resister moulded of firesand, which has a high electrical resistance, is refractory, and is unaffected by carbon and CO. In the General Electric contact arc furnace the walls may be of carborundum shapes, highly refractory, and with a low coefficient of expansion, thus avoiding metal leakage. Arc furnaces in ferrous service may have roofs of carborundum held very close to the bath, which is desirable, but only if the electrodes enter through insulating sleeves. In non-ferrous practice the rotative furnaces are popular, heating the metal largely from the lining, which of course must withstand the mechanical wear. To

reduce the extreme first cost, an effort is now being made to develop a composite lining, consisting of a thin inner coat of carborundum, a stout backing of cheaper refractory, and an outer sheath of insulator. As a matter of fact, the discovery of a really good insulator which stands up and still insulates when heated to a high temperature would cause a revolution in the use of refractories. At present low-melting bricks are purposely cooled, wasting enormous quantities of heat in order to maintain the furnace structure. With an efficient insulator a thin lining of some really heat-resistant material could be used, whose present use to build walls is prevented on account of its high cost.

During the discussion Mr. Stull, of the Columbus Station, U.S. Bureau of Mines, together with Mr. H. F. Staley, of the U.S. Bureau of Standards, pointed out the direction from which new and better refractories might be expected. A study of the SiO_2 : Al_2O_3 equilibrium diagram revealed one compound, sillimanite, with a melting temperature about 1,820 deg. C. This mineral is not available in commercial amounts, but a synthetic product of this composition has been made and used. Commercially it is manufactured by mixing proper proportions of fireclay and bauxite, grinding and calcining at 2,700 to 2,800 deg. Fah. in a kiln. The resulting clinker is then crushed, bonded with a little of the original slurry, slop moulded, repressed, dried, and burned at the maximum temperature possible in the ordinary kiln (2,800 deg. Fah.—far below the melting point of sillimanite).

A similar compound, spinel ($MgO.Al_2O_3$), occurs in that system, melting at about 2,130 deg. C. Like sillimanite, it should remain rigid nearly up to its melting point—melting at a fixed temperature, and not, like a fireclay, through a temperature range. Spinel brick has double the life of magnesite when used as charging doorsills, and should be no more expensive in first cost.

Zirkite bricks, made from calcined zirconium carbonate, are also in experimental use. Unfortunately the commercial carbonate usually is high in silica. Zirconia also reacts easily, forming carbides at high temperatures. The last fault does not apply to zircon brick, made of the mineral ZrO_2,SiO_2. This compound melts at about 2,560 deg. C., but it is very difficult to make brick with a satisfactory bond. Ground ore is the best agent, but this requires a burning temperature far above the possibilities of any but an electric furnace. Even here the difficulties in getting a uniform high temperature throughout a large volume are obvious and almost insurmountable. Fused zircon, according to Staley, has permanent volume. It is an acid refractory, being attacked by basic slags and hydrofluoric acid, but not by molten silica. It has a low coefficient of thermal expansion, but at the same time a low thermal conductivity; consequently it is liable to check badly on sudden temperature changes. It has a high electrical resistance. All in all, and especially in view of the occurrence of the mineral zircon in quantity, this refractory presents the best chances for immediate improvement for acid linings..

Foundry Conveyors.

Savings in time, space and materials, coupled with greatly increased production, resulted from the installation of a system of conveyors in the No. 2 foundry of the Hamilton Foundry and Machine Company, Hamilton, Ohio. The system has also greatly decreased the number of castings rejected, as foremen are enabled to keep a closer check on operations. The foundry is turning out transmission housings for tractors, and continued requests for increased production led the officials to install the conveyors. Since their installation the output has been increased 200 per cent. per sq. ft. of floor space.

At the present time four units, each consisting of one pouring and two return conveyors, are in operation, and a fifth unit is now being installed. The conveyors are installed crosswise in the main bay, the moulding being done in the side bay at one end, and shaking out at the other. The conveyors on which the moulds are poured are 50 ft. long, and capable of holding at one time 22 moulds. When the moulds are finished they are placed on the conveyors, which travel at the rate of 15 in. a minute. The pouring is done by a crane ladle while the moulds are moving, and about 30 minutes on the average elapses between pouring and shaking out.

Each conveyor is operated as a separate unit, so that in case of accident to one conveyor production continues on the others.

When the moulds reach the end of the pouring conveyors they are picked up by air hoists and deposited on Osborn jolt machines for shaking out. The sand, gaggers and wedges drop through the floor to an endless belt by which they are conveyed to a bucket elevator and carried upstairs to a rotary screen, which separates the gaggers and wedges from the sand and returns them by means of a chute to the moulders on the floor. The good sand drops from the screen into a hopper, and a man is stationed here to temper the sand before feeding it to a conveyor which carries it back across the shop to the revivifier. After being thoroughly mixed in the revivifier the sand is dropped to another conveyor and so delivered direct to the moulders' hoppers. From the time the sand leaves the moulder until its return about two hours elapse, and in a day's run the same sand may be used four times. As a means of insuring continuous operation, a sand storage bin of 70 tons capacity, directly connected with the conveyor system, is being built.

After the shaking out has been completed the flasks are returned to the moulders' side of the shop by gravity conveyors installed on each side of the pouring conveyor. One of these is used for the cope and the other for the drag machine.

The economies here are very apparent. By the use of the conveyors it is possible to get from 110 to 120 moulds from each conveyor in eight hours by using only 22 flasks. With 88 flasks in use 440 castings have been obtained in a day's run, whereas on straight floor work 110 flasks are required to secure the same number of castings in the same period of time, and four times the amount of space is needed to turn out the smaller amount of work.

The conveyor system also does away with the employment of a night force to shake out moulds and prepare sand for the next day's operations, as when the moulders complete their work everything is cleared up and in readiness for resumption of operations where left off the previous evening. Since the conveyors were installed approximately one-fourth of the sand and other materials are required as would be necessary to turn out the same amount of work on the floor. Another big advantage is that foremen are able to check the work one hour after the moulds are put up, and are able to correct any faults found in moulding or cores.

For smaller work another conveyor has been installed in the side bay. This conveyor is 30 ft. long, and has enabled the company to put up 325 moulds a day in the same space formerly required for 225.

Pouring is done by a ladle served by a chain hoist, and the moulds are shaken out by hand. Flasks are returned to the moulders by a gravity roller conveyor, but the small space in which operations are conducted makes installation of a conveyor for the sand unnecessary.

Production has so increased with the installation of the conveyors that it has been found necessary to install two new cupolas. The charging floor has also been greatly enlarged, and a system of transfer tracks installed capable of carrying enough charges for one day's run.

B

Trade Talk.

THE head offices of Drake & Gorham, Limited, have been removed to 36, Grosvenor Gardens, S.W.

THE CITROEN GEAR COMPANY have removed to new offices at 22, Buckingham Gate, Westminster, S.W.1.

VICKERS, LIMITED, have removed their Scottish depôt to Vickers House, 247, West George Street, Glasgow.

DAVEY, PAXMAN & COMPANY, LIMITED, have removed their London office to Central House, Kingsway, W.C.2.

THE BROOKE TOOL MANUFACTURING COMPANY, LIMITED, are building a block of offices at their Tyseley works, Birmingham.

MAY & PADMORE, LIMITED, have removed from Leopold Street, Birmingham, to the new works they have built at Tyseley, Birmingham.

EARLY in the new year the Institution of Electrical Engineers are to have their old home on the Victoria Embankment restored to them.

MR. W. SHARP, London representative of Wright, Anderson & Company, Limited, Gateshead-on-Tyne, has removed to 11, Pancras Lane, E.C.4.

CLAYTON WAGONS, LIMITED, of Lincoln, have been awarded a contract for 500 four-wheeled covered wagons for the Union of South Africa Railways.

SHEFFIELD STEEL PRODUCTS, LIMITED, have just obtained the whole of the Admiralty contracts for the supply of files, amounting to about 20,000 dozen.

THE MILLOM & ASKAM HEMATITE & IRON COMPANY, LIMITED, have commenced boring for ore in the Hensingham district, about two miles from Cleator Moor.

GORDON GOODGER & COMPANY, LIMITED, have established themselves in business as iron and steel merchants and exporters, at Suffolk House, Laurence Pountney Hill, London, E.C.4.

THE WESTMINSTER TOOL AND ELECTRIC COMPANY, Westool Works, Putney Bridge Road, London, S.W.15, have appointed Mr. T. M. R. Pinkney, Sunderland, as their North-East Coast representative.

MESSRS. JAMES LIVINGSTON & SON, scrap iron, metal, and machinery merchants, have removed their city office from 34, Gracechurch Street, E.C.3, to 77, Cannon Street, E.C.4, after being 50 years at the previous address.

THE ENGINEERING & GENERAL SUPPLY COMPANY, LIMITED, have taken over the entire business of the London House of the Smith-Eisemann Corporation of America, and have opened new offices at 17, Victoria Street, S.W.1.

OSWALD STOTT, LIMITED, Crown Buildings, James Watt Street, Birmingham, are now known as Standard and Oswald Stott (Engineers), Limited, and in future the business will be carried on at Evington Valley Road, Leicester.

THE No. 3 furnace at the Oldside Ironworks, Workington, of the United Steel Companies, Limited, recently produced 605½ tons of ferro-manganese. This was a record output for one furnace, so far as these works are concerned.

VERY extensive additions are being made to the Tyseley Works, Birmingham, of Components, Limited. Provision is made for extending the whole of the existing shops, as also for the erection of a commodious block of offices.

WITH the exception of India and U.S.A., the Alfred Herbert organisations at home and abroad were recently appointed sole distributors of the "Gambia" brand of files, manufactured by Joseph Peace & Company, Limited, Sheffield.

THE Central Commercial Department of Sir W. G. Armstrong, Whitworth & Company, Limited, has been removed from 3, Woodstock Street, Oxford Street, W.1, to 10, Great George Street, Westminster, S.W.1, the London head office of the firm.

THE SOUTHEND CORPORATION have been endeavouring, through the Glasgow Corporation, which recently placed contracts for tram rails with the United States to secure the acceptance by the same American concern of an order for tram rails for Southend.

THE opening of the new shipyard which has been laid down at Hebburn Colliery by Messrs. Renwick & Dagliesh, of Newcastle, has been postponed indefinitely. The constructional workmen engaged were on Saturday last given seven days' notice to terminate their employment.

HARLAND & WOLFF, LIMITED, have made a contract with the Port of London Authority to take over the whole of their engineering repairs and constructional work, and to construct buildings of a permanent character, and two slipways for ship-repairing and shipbuilding purposes.

W. G. ALLEN & SONS (TIPTON), LIMITED, Princes End, Tipton, in announcing the death of Mr. G. A. Allen, J.P., state that arrangements have been made whereby the business of the company will be carried on as usual, MR. A. E. Allen and Mr. A. Weddell continuing to act as directors and managers.

THE FEDERATION OF BRITISH INDUSTRIES announce that at a meeting of Main Group 16 (non-ferrous metals), it was decided that five sub-groups should be formed as follows:—(1) Smelters; (2) copper, brass, and zinc manufacturers; (3) brass founders; (4) aluminium; (5) lead, antimony, tin, nickel, etc.

MR. F. A. RATHBONE, the secretary to Monks Hall & Company, Limited, was the guest at a complimentary dinner given by the officials of the company on the occasion of his silver wedding. Mr. M. R. Proudlock, the managing director, presided, and during the evening Mr. Rathbone was the recipient of a handsome presentation.

THE SHOTTS IRON COMPANY, LIMITED, to ensure adequate supplies of limestone for the ironworks of the company, have bought the lime works at Straiton, Loanhead, hitherto worked by the Clippens Lime Company. It is anticipated that the output will be largely increased, and that work will be provided for an increased number of men.

THE North Eastern Railway Company are proposing to erect new wagon shops, and to transfer to Darlington the workmen employed in this department at present at Shildon and York. The Cleveland Bridge and Engineering Company, Limited, have obtained the contract, and the work of levelling and laying out the grounds has been commenced.

THE name of Dobbie McInnes, Limited, has been changed to Dobbie M'Innes & Clyde, Limited. This alteration involves no change in the constitution or in the management of the business, with which Mr. W. P. Clyde, whose name is now added, has for many years been identified as managing director, and in which capacity he will continue to act.

FIVE vessels have been launched from Sunderland shipbuilding yards during the month of October, with an aggregate tonnage of 26,260 tons, making the total for the ten months of the current year 56 vessels of an aggregate tonnage of 249,428 tons. The launches over the corresponding ten months of 1919 were 55 vessels, of an aggregate tonnage of 230,015 tons.

MESSRS. GROSS, SON & ROBERTSHAW have been appointed sole selling agents for Wild-Barfield electric furnaces for the counties of Northumberland, Durham, Cumberland and Yorkshire. In addition to their office in Newcastle Messrs. Gross, Son & Robertshaw have opened a branch office at 41, Great George Street, Leeds, where a demonstration furnace is in course of erection. Macbeth Bros. & Company, Limited, of Bombay and Calcutta, have taken over the sole selling rights for India.

THE AMBLE SHIPBUILDING COMPANY, LIMITED, a subsidiary of Palmers Shipbuilding & Iron Company, Limited, are now commencing building operations. Palmers Company have now laid the yard out and equipped it with all modern appliances for the building of smaller steel craft, which can be constructed there more advantageously than at Jarrow or Hebburn. All the plant has been been practically installed, and it

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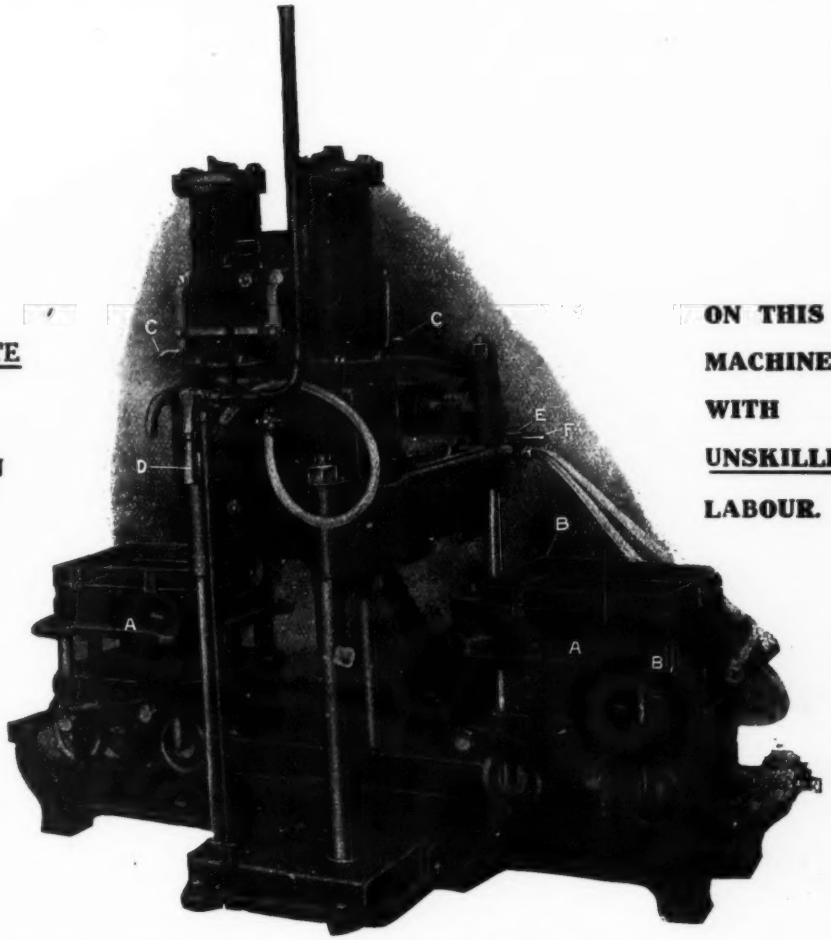
OF EVERY DESCRIPTION.

Pneumatic, Hydraulic, Jar Ramming, & Hand Power.

Type "A" Duplex Machine for Pneumatic Power.

Fitted with self-adjusting Rammer Head which accommodates itself to any varying depth of pattern.

OVER 50 COMPLETE MOULDS PER HOUR HAVE BEEN PRODUCED



ON THIS MACHINE WITH UNSKILLED LABOUR.

One of many that we have installed in various Munition Work Centres.

JAMES EVANS & CO., BRITANNIA WORKS, BLACKFRIARS, MANCHESTER.

B 2

is expected that the whole establishment will be in full working order by the end of the year. The keel of the first vessel has just been laid.

Sir Robert Hadfield, Bart., in a recent letter to the "Times," controverts statements made to the effect that attempts were being made by the United States and France to bring about arrangements with regard to iron and steel products which would be inimical to the interests of this country. He states that his investigations go to prove that no such arrangements had been made or contemplated, and he points out that the relations between the American and British iron and steel makers have always been, and still are, very good. "There is (concludes Sir Robert Hadfield) plenty of room in the world for all of us in this line of work, that is, the production of iron and steel. In my opinion a most desirable point at the present time is to get down the prices. Civilisation, with its enormous demands for iron and steel products, cannot advance as it should do if we are to go on paying the present high figures. Enterprise must be severely checked, and for that reason I am an advocate for trying to return to a saner policy than at present seems to prevail in the world. High prices must mean greatly reduced demand, consequently less production, which only adds to our troubles. What we all want to do is to put our shoulder to the wheel and produce, produce, produce."

If there was ever any truth in the charge so frequently levelled in pre-war years at the British manufacturer that he was too conservative, lacked adaptability, and was unwilling to investigate conditions abroad, it certainly cannot now be said that the British manufacturer is not fully alive to the possibilities of foreign trade. As our bright little contemporary, the "Edgar Allen News," points out, probably the truth is that while the British captains of industry were as enterprising and energetic as their foreign competitors, they were backward in letting people know about it. Since the inception of the business, it has always been the policy of the directors of Edgar Allen & Company, Limited, to visit the various countries with which they do business, thus acquiring on the spot the knowledge requisite for successful trade. During the war, of course, this policy was interrupted, but it has since been resumed. Mr. J. C. Ward returned only recently from a tour embracing America, Canada, Japan and China. Mr. J. F. Moss is about to visit South America, this being his second visit to that continent. France, Belgium, Italy and Spain have also in the past twelve months been visited by one or other of the directors. The effect of these directorial visits is supplemented by the appointment of works-trained technical men to continue the policy. Mr. B. Butterfield's attachment to the staff of Agar Cross & Company, the firm's agents in Argentina, is the most recent instance of this.

Under the auspices of the Federation of British Industries a meeting was held in London on November 4 to discuss the formation of a British-China Trade Corporation to develop a Charter, granted for the first time in history, to give British traders the right to develop an industrial area in China outside the limits of the Treaty Ports. Colonel O. C. Armstrong presided. Sir John Jordan (late Minister at Pekin) alluded in the course of an address to the difficulties hitherto experienced in embarking upon industrial projects in China. So far no more than the fringe of the potentialities of China as a great manufacturing country had been touched. Mr. J. O. P. Bland, in outlining the proposals for the Corporation, said he was in Pekin in January and February last, and, looking into the general subject of British interests, compared what had been done with what might be done. With regard to the broad basis on which the Federation asked for this Corporation to be established, Mr. Bland said that the Chinese at first thought that when the charter was first proposed in August, 1919, one or two British firms might take it up, and that it would gradually spread, but later on they came to the conclusion that the broader the basis on which the manufacturers of Great Britain could be appealed to the better. At present British manufacturers could only trade at the treaty ports, but directly they got Chinese partners they could go and trade in the interior and would also have the advantage of obtaining Chinese capital. The chairman said he thought that this Corporation was of such very grave importance that they should do their utmost to see whether they could not bring it into life as an operative financial development organisation in China. There was a big field for it, and if they did not take this opportunity they might find that their charter was cancelled and that someone else would step in and get the benefit of all that had been done.

The outstanding feature of the lead and zinc mining industry in the Lake country at the present time is the threatened stoppage of the famous Greenside mine at Pattordale. Owing to circumstances over which the company has no control, costs are greater than can be met, and the company has decided to close down the mine, which has been working for over one hundred years, on the termination of the lease in 1922. The position generally in the zinc industry is that smelters have practically ceased operations all over the country. The price of spelter is a good deal below the cost of production, and Belgium has ceased production. There is very little sale for blende at the present time, but several parcels have been shipped to Antwerp at prices representing about £6 per ton at the mines for 50 per cent. ore. There is no probability of the resumption of operations at the zinc works until spelter rises to at least £30 per ton, though it is generally anticipated that such a figure will be commanded within the next five or six months. Lead at the present time is not a payable proposition, and production, therefore, is exceedingly meagre. Thornthwaite is not looking very well, and the output has fallen slightly. Force Croz has closed down. Threlkeld, however, is increasing its production, and the fact that there are no pumping charges to be borne will probably enable this mine to continue in full work. Underground developments are reported to be most encouraging. The owners are credited with the intention to instal some new plant which will improve recovery, and there is also talk of the installation of electric underground haulage, as the workings are about a mile from the surface. In the Alston district the Vieille de Montagne Company is still working the Nenthead mine on a limited scale, and the developments there are promising. The Weardale mines output is rather larger, and prospects are better. A large tonnage of fluorspar is being secured, which is being shipped abroad, as well as being sent to the local steelworks. The demand is firm at the present time, and prices are not unsatisfactory.

Applications for Patents.

Burden, E. Aluminium alloys, and preparation thereof. 28,087. October 4.

Chambers, P. Treating iron and iron alloys. 23,745. August 13.

Duckham, Sir A. M. Heating materials at successively-different temperatures. 29,678. October 20.

Duckham, Sir A. M. Furnaces for producing chemical changes. 30,059. October 23.

Electrolytic Zinc Company. Treatment of finely-divided zinc. 30,057. October 23. (Australia, October 24, 1919.)

Fisher, W. H. Treating iron and iron alloys. 23,745. August 13.

Friedrich, K. Process for production of glaze-like mineral coatings for iron. 29,370. October 18. (Germany, October 18, 1919.)

Green, L. Railway-rail chairs. 29,704. October 21.

MACNAB & Co.

TABOR MOULDING MACHINES (TABOR PATENTS)

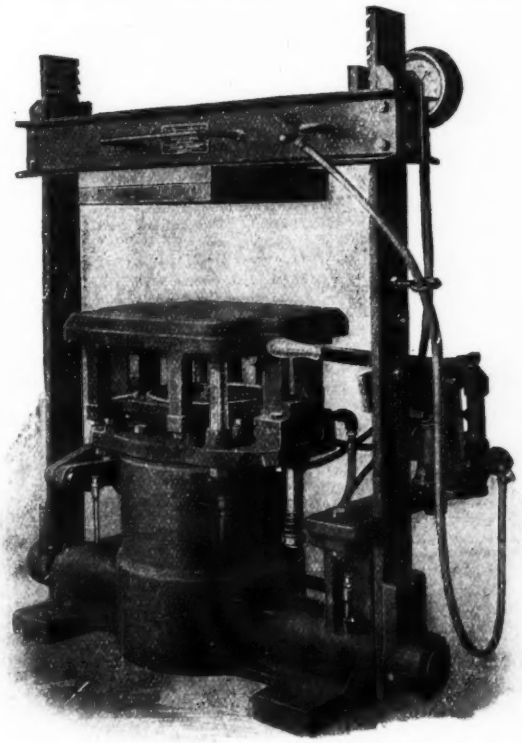
For Every Class of Work.

Pit Type and Portable Combination Shockless Jar Ramming Power Roll-over and Pattern Drawing Machines; Power Squeezing and Jar Squeezing Machines; Shockless Jarring Machines, etc., etc.

SPECIAL FEATURES AND ADVANTAGES:

Accurate Definite Draw with Permanent Accurate Alignment.

All Operations Controlled by One Lever.



Uniformity in size of Castings produced.

All Moulds squeezed alike to whatever Pressure Required.

Minimum Percentage of Wasters.

The above illustrates the TABOR POWER SQUEEZING "SPLIT PATTERN" MOULDING MACHINE, specially suitable for all small patterns which can be split in halves or for flat back work.

Capacities and Dimensions furnished upon application:

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Works: TOTTENHAM, LONDON, N.17.

Liebermann, S. Apparatus for filing, smoothing, etc., metal, etc. 28,637. October 9.
Schmieding, P. Regenerative furnaces. 27,898. October 1. (Germany, June 30, 1919).
Tilgham's Patent Sand Blast Company. Air, etc., pumps and compressors. 28,321. October 6.
Turner, E. Crucible furnaces. 28,049. October 4.
Vulcan Foundry, Limited. Dies, etc. 27,691. September 29.
Wood, C. E. Bending, twisting, etc., metals. 27,914. October 1.

Personal.

MR. S. H. MORDEN has been elected a director of H. J. Skelton & Company, Limited.

MR. W. T. DAVID has been appointed Professor of Engineering at the University College of South Wales and Monmouthshire.

MR. T. FURNESS and Mr. J. E. James (general works manager) have been elected directors of the Cargo Fleet Iron Company, Limited.

MR. L. E. LITTLE, managing director of the Northern Ball Bearings, Limited, has joined the Ransome & Marles Bearing Company, Limited.

MR. P. J. WORSLEY has been appointed joint general manager of the Screw Department at Birmingham of Guest, Keen & Nettlefolds, Limited.

THE late Mr. B. W. Winder, a master of metallurgy in Sheffield University, and chairman of Jonas & Colver, Limited, left estate valued at £70,218.

THE late Mr. E. G. Kirkhouse, manager of the blast-furnace department at the Consett Iron Company's works, left gross estate of the value of £8,408.

THE will of Sir Frank Mappin, chairman and managing director of Thomas Turner & Sons, Limited, has been proved at £810,668, with net personalty £795,839.

MR. G. W. JENKINS has been appointed manager of the Cardiff Goods Section of the Great Western Railway Company in succession to the late Mr. J. Bassage.

THE late Mr. A. G. Preston, of Monks Orchard, West Wickham, Kent, retired manufacturing engineer, left estate of the gross value of £195,874, with net personalty £188,229.

DR. ANGUS FULTON, Lecturer on Engineering at Dundee, has been appointed by the University Court of St. Andrews to the vacant chair in Engineering at the University College, Dundee.

BRIGADIER-GENERAL MAGNUS MOWAT has been appointed to fill the vacancy caused by the retirement of Mr. Edgar Worthington from the position of secretary of the Institution of Mechanical Engineers.

SIR J. FORTESCUE FLANNERY, BART., M.P., has been elected chairman of W. & T. Avery, Limited, in succession to the late Mr. Walter Chamberlain. Mr. A. H. Gibson has been elected vice-chairman of the company.

MR. J. H. MEIKLEJOHN has resigned his position as engineer to the Broughton Copper Company, Limited, and has secured the appointment of engineer to the Austral Bronze Company, Botany Road, Alexandria, Sydney.

MR. E. THOMPSON, for eight years carriage and wagon superintendent of the Great Northern Railway at Doncaster, has been appointed manager of the carriage and wagon department of the North-Eastern Railway at York.

MR. H. ECCLES, manager director of the Briton Ferry Steel Company, Limited, on his resignation of the presidency of the South Wales Siemens Steel Association, has been the recipient of a handsome presentation from the members.

MR. A. H. MUNDEY has joined the staff of Fry's Metal Foundry as London manager. Mr. G. W. Gibson, of Manchester, has been transferred to London, and Capt. J. Cartland has been appointed manager of the foundry at Manchester.

SIR ERNEST JARDINE, BART., governing director of John Jardine, Limited, has received information from the French Minister of Commerce that the honour of the "Croix de Chevalier de l'Ordre National de la Legion d'Honneur" has been conferred upon him by the President of the French Republic.

MR. W. DONALD, after 15 years' service in the brass foundry department of the works of Sir W. G. Armstrong, Whitworth & Company, Limited, at Elswick, latterly as assistant works manager, has resigned in order to take up the position of manager of works in London.

THE late Mr. W. Chamberlain, chairman of W. & T. Avery, Limited, and a director of Joseph Lucas, Limited, Charles Churchill & Company, Limited, and the Churchill Machine Tool Company, Limited, left estate of the gross value of £83,861, with net personalty £78,404.

MR. S. W. GLADWELL (secretary of the Iron Trade Employers' Association, Limited) has been elected president; Messrs. C. E. Musgrave (secretary of the London Chamber of Commerce) and W. N. Bancroft (secretary of the Midland Railway Company), vice-presidents; and Mr. A. F. Harrison (secretary of the City of London Electric Lighting Company, Limited), treasurer of the Chartered Institute of Secretaries.

THE gold medal of the Institution of Mining and Metallurgy, has been awarded to Sir Thomas Kirke Rose, "in recognition of his eminent services in the advancement of metallurgical science, with special reference to the metallurgy of gold." "The Consolidated Gold Fields of South Africa, Limited," gold medal and premium have been awarded to Mr. H. Livingstone Sulman, for his paper: "A Contribution to the Study of Flotation."

MR. W. G. C. WYLDE, who for many years has been associated in the management of the firm of Samuel Tyzack & Company, Limited, of Sunderland, has, owing to health reasons, resigned his position as secretary, retaining his seat on the board of directors. Mr. J. Jones, the whole of whose commercial life has been spent at Messrs. Tyzack's, has been appointed secretary to the company, and Mr. B. W. Boyes, of the South Durham Steel and Iron Company, Limited, took over and joined the board.

THE King has made the following appointments to the Most Excellent Order of the British Empire for services in connection with the war:—Officers of the Civil Division: Mr. J. W. Milne, Section Director, Machine Tools Department, Ministry of Munitions; Mr. W. E. Parker, Technical Manager, Hadfields, Limited. Members of the Civil Division: Mr. V. Gartside, Machine Tools Department, Ministry of Munitions; Mr. R. M. Hook, Assistant Engineer, General Post Office; Mr. C. Lambourne, Non-Ferrous Materials Supply Department, Ministry of Munitions; Mr. W. Shackleton, Chief Engineer, Sheffield Simplex Motor Works, Limited; Mr. A. J. Thorneloe, assistant manager at one of the works of Sir W. G. Armstrong, Whitworth & Company, Limited.

Deaths.

MR. T. B. BIRKBY, chairman of Fleming, Birkby & Goodall, Limited, of Liversedge, died recently at the age of 74 years.

THE death took place very suddenly on October 16 of Mr. D. M'Naughton, secretary of the Lanarkshire Steel Company, Limited, at the age of 47 years.

MR. F. L. CROFT, governing director of Crofts (Engineers), Limited, Thornbury, Bradford, died on November 5 at Draycombe, Morecambe, in his 64th year.

THE death is announced of Lieut.-Colonel Sir Gerald Smith, of Cromwell Road, S.W., the first chairman of the Hull and Barnsley Railway and Dock Company.

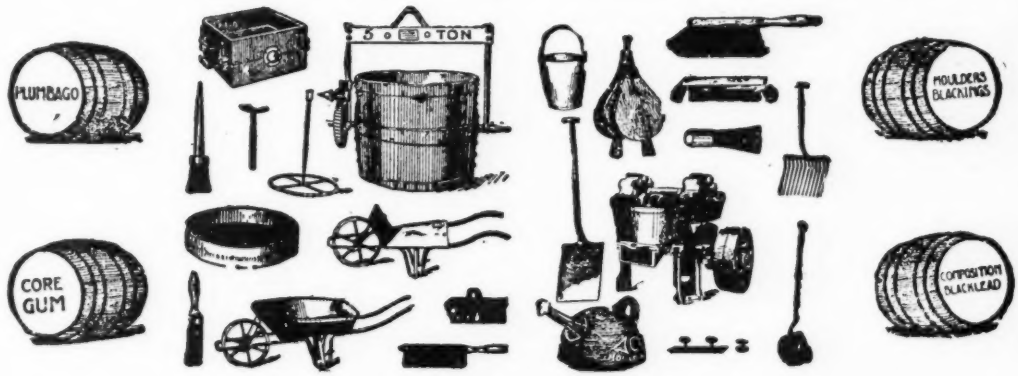
MR. E. TOWERS, of Newcastle, died on Sunday, November 13, at the age of 82. He was for a considerable time manager of Abbott's Engineering Works, Gateshead, retiring when the works closed down some years ago.

Telephone: 21, Penistone. Telegrams: "Durrano, Penistone."

Established 1863.

JAS. DURRANS & SONS,

Phœnix Works, Penistone, Near Sheffield.



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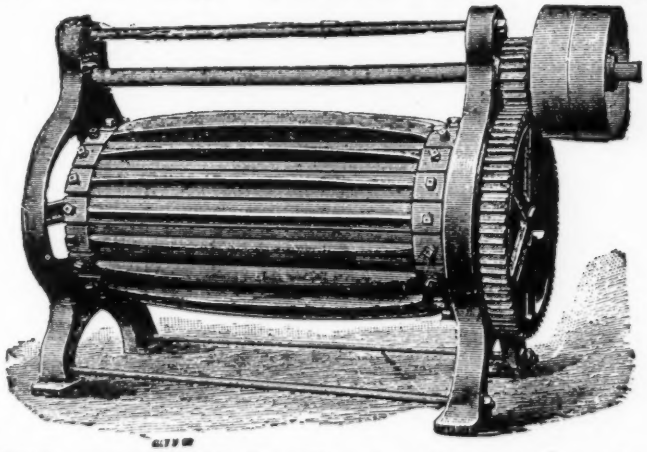
FOUNDRY EQUIPMENTS

COMPOSITION BLACK LEAD, PLUMBAGO, CORE GUM, WHITE DUST & COAL DUST

Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, Etc.

Improved Foundry Rattler or Fettling Drum.



These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

The following testimonial explains itself :—

"Dear Sirs,—We have been using your best Blacking for a large number of years, and always use it on our large Ingot Moulds, which, as you know, we have made up to 85 tons in weight.

Yours faithfully. THE BRIGHTSIDE FOUNDRY & ENGINEERING CO., LD.

MR. L. JENKINS, of Messrs. T. Jenkins & Sons, metal merchants, Briton Ferry, a director of the Briton Ferry Steel Company, Limited; the Baglan Bay Tinplate Company, Limited, and the Villiers Tinplate Company, Limited, died recently at the age of 70 years.

THE death took place recently at Sydney, New South Wales, of Mr. A. R. Lysaght, at the age of 57 years. The deceased gentleman was the son of the late Mr. J. Lysaght, who founded the business of John Lysaght, Limited. Mr. A. R. Lysaght was a director of Lysaght Bros. & Company, Limited, of Sydney, N.S.W., manufacturers of wire, wire netting, and nails.

MR. WILSON HARTNELL, one of the oldest engineers in the Leeds district, has died at his residence, Aysgarth, Roundhay, in his 82nd year. Mr. Hartnell, who was a member of the Institution of Mechanical Engineers, was especially well known in Leeds, where he was head of the firm of Wilson Hartnell & Company, Limited, manufacturers of electric light and power plant.

MR. D. LLOYD died on Sunday at Pontypridd. The deceased left Cardiganshire about 30 years ago for Ynysybwl, where he started his mining experience at the Windsor Colliery. He obtained a first-class certificate for mining, held appointments as fireman and overman at the Windsor Colliery, and afterwards as manager of Taylor's Navigation Colliery at Nantgarw, a position he held until his resignation, about two years ago.

WE regret to announce the death, which took place quite unexpectedly on October 27, at his residence at Pedmore, near Stourbridge, of Mr. G. A. Allen, J.P., senior director of W. G. Allen & Sons (Tipton), Limited, engineers, iron and steel workers, Princes End, Tipton, Staffs. The sudden death of Mr. Allen will have been a shock to his numerous business friends, with whom he had been in personal contact for a number of years.

THE death occurred on November 25, after a brief illness, of Mr. F. E. Muntz, of Umberslade Park, Hockley Heath. Born in 1845, the deceased gentleman was a son of the late Mr. G. F. Muntz, and a nephew of the late Sir Albert Muntz, M.P. Although a well-known agriculturist, Mr. Muntz was also prominent in commercial circles, being chairman of the Horseley Bridge and Engineering Company, and chairman of the Knowle and District Gas Company, and a director of the Littleton Collieries.

THE death took place recently of Mr. J. Stubbs, of Fircroft, World's End, Solihull. Mr. Stubbs, who had just entered upon his sixtieth year, had been unwell for many months, but attended to business matters until quite recently. He was the eldest son of the late Mr. Joshua Stubbs, of the Pitney Rolling Mills, and in 1895 he founded, in conjunction with Messrs. J. & J. Hughes, the Hughes Stubbs Metal Company, Plume Street, Aston, of which, up to the time of his death, he was managing director. Following upon a recent grouping of interests he was also a director of Cooper & Goode, Bradford Street, and of Elliott's Metal Company, Selly Oak. He was also a director of the Concordia Electric Wire Company, New Sawley, near Derby.

WE regret to learn of the death of Mr. Franklin Hilton, of Southport, which took place on November 16. He was born in 1844, and educated at Stand Grammar School. Showing an early bent for engineering, he was apprenticed to the locomotive department of the East Lancashire Railway Company (afterwards merged into the Lancashire and Yorkshire Railway Company), and after completing his apprenticeship served for short periods as draughtsman with Messrs. Sharp, Stewart & Company, the Yorkshire Engine Company, and Charles Cammell & Company, Limited, of Sheffield. In 1873 he received an appointment as chief designing engineer to the Ebbw Vale Company, and afterwards took up the post of chief mechanical engineer of the Rhymney Iron Company. In 1879 he went to Messrs. Bolckow, Vaughan & Company, Middlesbrough, as engineer, subsequently undertaking the post of general manager, succeeding Mr. E. Windsor Richards. He later returned to Ebbw Vale as general manager of the coal, iron and steel works there. He retired to Southport in 1895, but has been a useful member for many years of the board of two or three companies, including Messrs. Browett, Lindley & Company, Patricroft, Manchester, and J. Grayson, Lowood & Company, Limited, Sheffield. Mr. Hilton's wide and varied experience made him well known in the industrial world, and his loss will be felt by a large circle of friends.

New Companies.

J. P. Chain & Gear Company, Limited. — Capital £12,500 in 10s. shares.

Glasgow Oxy-Electric Welding & Metallurgical Company, Limited.—Capital £5,000 in £1 shares.

Newcastle & Sunderland Oxy-Electric Welding and Metallurgical Company, Limited.—Capital £5,000 in £1 shares.

Northampton Foundry Company, Limited.—Capital £10,000 in £1 shares. Registered office: Balfour Road, Northampton.

Metal Stampings Company, Limited. — Capital £17,000 in 15,000 preference of £1, and 8,000 management of 5s.

Sandham Engineering Company, Limited. — Capital £5,000 in £1 shares. Registered office: 336, Gray's Inn Road, W.C.

Webirkoate, Limited.—Capital £7,000 in £1 shares, to carry on the business of engineers. Registered office: 111, Kingsland Road, E. 2.

Deane Brothers, Limited. — Capital £5,000 in £1 shares, to carry on the business of engineers. Registered office: The Beeches, Hambledon.

John Shann, Limited.—Capital £10,000 in £1 shares, to carry on the business of engineers. Registered office: 5, Altrincham Street, Manchester.

Reliance Gear Company, Limited.—Capital £3,000 in £1 shares. Directors: S. B. Byron, E. E. Law, and Miss D. Ellis. Registered office: Huddersfield.

Hadfield & McKenna, Limited.—Capital £5,000 in £1 shares, to carry on the business of engineers. Registered office: Charles Street, Chorlton-on-Medlock.

Hartley & Baldwin.—Capital £25,000 in £1 shares (10,000 pref.), to carry on the business of bolt manufacturers. Registered office: Job Street, Burnley.

Hughes & Wright, Limited.—Capital £10,000 in £1 shares, to carry on the business of engineers. Registered office: Grand Garage, King Street, Oldham.

W. Martin & Son, Limited.—Capital £10,000 in £1 shares (1,750 7½ per cent. cumulative preference), to carry on the business of engineers. Registered office:

Metcalfe, Duncan & Company, Limited. — Capital £5,000 in £1 shares, to carry on the business of iron merchants. Registered office: 59, High Street, Dalkeith.

James & Jarrett, Limited.—Capital £25,000 in £1 shares, to carry on the business of civil engineers. Registered office: Salisbury Chambers, Castle Street, Cardiff.

David M'Donald & Son, Limited.—Capital £12,000 in £1 shares, to carry on business as iron and steel founders, etc. Registered office: New Park Street, Hamilton.

Callie & Company (Liverpool), Limited. — Capital £4,000 in £1 shares, to carry on business as welders and metal stampers. Registered office: 20, North John Street, Liverpool.

Wheeler & Comyn Ching (Asia), Limited. — Capital £30,000 in £1 shares, to carry on the business of engineers. Registered office: 24, Little St. Andrew Street, Long Acre, W.C.

Samuel Warren, Limited. — Capital £40,000 in £1

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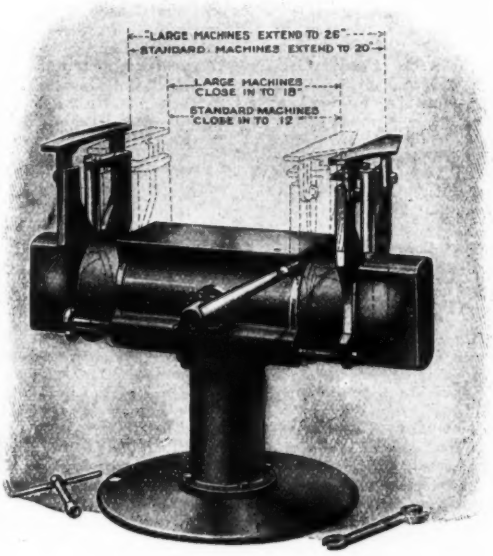
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MOULDING MACHINES,
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shares, to carry on the business of ironmasters at Sheffield. Directors: S. Warren, A. Cattell, J. Johnson and F. Chapman.

Barduff, Limited. — Capital £100 in £1 shares, to carry on the business of engineers. Directors: N. E. Dufty and F. R. Baerlocker. Registered office: 4, Arlington Road, West Ealing.

W. T. Underwood, Limited.—Capital £5,000 in 4,900 ordinary shares of £1 and 2,000 founders of 1s., to carry on the business of engineers. Registered office: Cresswell Road, Clowne, Derbyshire.

Lyon & Company (Dudley), Limited. — Capital £15,000 in £1 shares, to carry on the business of manufacturers of and dealers in iron, steel, etc. Registered office: 7, Priory Street, Dudley.

Harwood Manufacturing Company, Limited.—Capital £3,000 in £1 shares, to carry on the business of stampers, piercers, etc. Registered office: Cornwall Buildings, 45, Newhall Street, Birmingham.

A. H. Rees, Limited.—Capital £1,500 in 1,500 10 per cent. cumulative preference shares of £1 each, to carry on the business of shipowners, colliery agents, etc. Registered office: 124, Bute Street, Cardiff.

Bramco (1920), Limited.—Capital £3,750 in 1s. shares, to adopt an agreement with Bramco and T. V. Redston, liquidator, and to carry on the business of engineers, etc. Registered office: 2, Radford Villas, Coventry.

John Thompson (Gas Developments), Limited. — Capital £175,000 in £1 shares, to adopt an agreement with J. Thompson, A. E. Thompson, W. J. Thompson, and S. J. Thompson. Registered office: Ettingshall, Staffs.

Earlsfield Foundry & Engineering Company, Limited —Capital £3,000 in £1 shares. Directors: W. J. Woodrow, J. W. Woodrow, W. Joseph Woodrow, and A. C Woodrow. Registered office: Summerly Street, Earlsfield, London, S.W.

D. Black & Company, Limited.—Capital £27,000, divided into 25,000 A ordinary and 2,000 B ordinary shares, both of £1 each, to carry on the business of engineers. Registered office: Washington Street, Govan, Glasgow.

H. G. Hawker Engineering Company, Limited. — Capital £20,000 in £1 shares. First directors: F. I. Bennett, H. G. Hawker, T. O. M. Sopwith, F. Sigrist, and V. W. Eyre. Registered office: Canbury Park Road, Kingston-on-Thames.

Trident Trading Company, Limited.—Capital £2,000 in £1 shares, to carry on business as metal brokers, coal, coke, and patent fuel factors, etc. B. Pardoe-Thomas is permanent chairman. Registered office: 116, Dock Street, Newport, Mon.

Edward Howell & Company (Galvanisers), Limited.—Capital £5,000 in £1 shares, to take over the business of a galvaniser and general ironworker, etc., carried on by C. W. Howell at 93, Freeth Street, Birmingham, as Edward Howell & Company.

Hill & Hall (Successors), Limited.—Capital £10,000 in £1 shares, to carry on the business lately carried on as Hill & Hall, of Wolverhampton Street, Walsall, and to carry on the business of engineers, etc. Registered office: Wolverhampton Street, Walsall.

H. and A. Brown, Limited.—Capital £5,000 in £1 shares, to take over the business of an engineer, founder, etc., carried on by W. H. Brown at Holbeck, Leeds, as H. and A. Brown. Registered office: Brookhall Works, Meadow Lane, Leeds.

Bramble Sheet Metal Company, Limited. — Capital £2,500 in £1 shares, to take over the business carried on by A. F. Bond and A. Rosier, at Chapel Street, Coventry, as the Bramble Sheet Metal Company. Registered office: 65, The Butts, Coventry.

Brannan & Garnett, Limited.—Capital £2,000 in £1 shares (500 pref.), to take over the business of tool makers, carried on at 94a, Scotland Street, Sheffield, as Brannan & Garnett. Directors: F. Emmerson and W. Sheffield. Registered office: 94a, Scotland Street, Sheffield.

Woodburn Manufacturing Company, Limited. — Capital £2,500 in £1 shares, to carry on the business of manufacturers, importers, and exporters of and dealers in iron, steel, and machinery of all kinds, etc. Directors: J. Oxley and Mrs. M. Oxley. Registered office: Woodburn Road, Sheffield.

Edgar G. Rees, Limited. — Capital £50,000 in £1 shares, to acquire the business carried on in Carmarthenshire and elsewhere as Edgar G. Rees, and to carry on the business of iron merchants, etc. Directors: E. Jones and E. G. Rees (managing director). Registered office: Castle Buildings, Llanelly.

London Warming Company, Limited. — Capital £50,000 in £1 shares, to take over the business of the London Warming & Ventilating Company, Limited (incorporated in 1901). Directors: F. Cleeves, A. P. Florence, and H. Goodman. Registered office: 20, Newman Street, Oxford Street, London, W.

T. J. Grainger & Company, Limited.—Capital £5,000 in £1 shares, to take over the business of a dealer in electrical goods and colliery and engineering tools and appliances carried on by T. J. Grainger at 31, The Side, Newcastle. Directors: T. J. Grainger (permanent) and C. Meakin. Registered office: 31, The Side, Newcastle.

Drypool Engineering & Dry Dock Company, Limited. —Capital £80,000 in £1 shares, to acquire the undertakings of the Hull Dry Dock & Ship Repairing Company and the Drypool Engineering Company (Hull). Directors: R. W. Wheeldon (chairman), T. C. Spink, R. Rix, J. R. Rix, E. B. Rix, and T. Tate. Secretary: H. R. Rix. Registered office: 88, Church Street, Hull.

Bwlchgwyn Silica Company, Limited. — Capital £60,000 in £1 shares. Directors: F. H. Brooke, E. H. Saniter, C. P. Williams, T. A. Acton, P. B. Brown, and F. Percy. The Oughtbridge Silica Firebrick Company, Limited, may while holding 20,000 shares, be represented on the board by three directors. Secretary: C. Jones. Registered office: 43, Regent Street, Wrexham.

The British Cutlery Research Association.—Registered as a company limited by guarantee, to promote research and other scientific work in connection with the cutlery trade. Council: J. B. Allen, F. B. Colver, F. Charles, J. M. Denton, J. A. Innocent, T. H. Edwards, W. Royse, E. J. Oxley, E. Priestman, W. Ragg, H. Reynolds, R. W. Walker, and G. H. Street. Registered office: 223, Portobello Street, Sheffield.

Mitchell, Shackleton & Company, Limited.—Capital £200,000 in £1 shares (25,000 preferred), to acquire the undertaking of Mitchell, Shackleton & Company, Limited (incorporated in 1907), and to carry on the business of metal workers and engineers, etc. Directors: E. Shackleton, E. Mitchell, and K. S. Prescott (all permaent). Registered office: Vulcan Works, Patricroft, Lancs.

Cleworth, Wheal & Company, Limited. — Capital £100,000 in £1 shares, to adopt an agreement with A. B. Cleworth and W. Wheal, and to carry on the business of constructors of apparatus for cooling, heating, humidifying or cleansing air, gas, etc., as formerly carried on at the Grange Works, Castleton, Lancs. Directors: A. B. Cleworth (permanent managing director) and A. G. Knight. Registered office: Grange Works, Castleton, Lancs.

Consolidated Steel Corporation. — Incorporated in Delaware, U.S.A., on January 2, 1919; authorised capital stock of $10,000,000 in 100,000 shares of $100 each; chief object to engage solely in export trade as the term is defined in the "Webb Act" of 1918. Principal office: 7, West 10th Street, Wilmington, County of New Castle, Delaware; British address, 139, Fenchurch Street, E.C., and C. M. Sanders, metal merchant and broker, is the corporation's sales agent for Great Britain. The corporation are sole exporters of the produce of the Bethlehem Steel Company, the Brier Hill Steel Company, the Cambrian Steel Company, the Lackawanna Steel Company, the Lukens Steel Company, the Midvale Steel & Ordnance Company, the Republic Iron & Steel Company, the Sharon Steel Hoop Company, the Trumball Steel Company, the Whittaker-Glessner Co., and the Youngstown Sheet & Tube Company.

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DEEPCAR nr. SHEFFIELD.

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MONTHLY PRICE LIST.

The undermentioned prices, unless otherwise specified, are those obtaining at the commencement of the current month.

Pig-Iron.

	Home £ s. d.
Hematite—	
East Coast Mixed Nos.	13 0 0
East Coast No. 1	13 2 6
West Coast Mixed Nos.	14 15 0
Scottish Mixed Nos.	14 5 0
Welsh Mixed Nos.	14 0 0
Cleveland—	
No. 1	11 17 6
No. 3 foundry G.M.B.	11 5 0
No. 4 foundry	11 5 0
No. 4 forge	11 5 0
Basic	11 15 0
Derbyshire, Leices., and Notts—	
No. 4 forge	13 0 0
No. 3 foundry	14 5 0
No. 2 foundry	14 6 6
No. 1 foundry	14 8 0
Basic	14 5 0
Northamptonshire—	
No. 4 forge	11 15 0
No. 4 foundry	12 12 6
No. 3 foundry	12 15 6
No. 2 foundry	13 17 0
No. 1 foundry	13 0 0
Basic	12 10 0
South Staffordshire, Shropshire and Worcestershire—	
Part-mine forge	13 2 6
Part-mine foundry	13 7 6
Common Staffs.	11 5 0
All-mine forge	14 7 6
All-mine foundry	14 12 6
Warm-air forge	13 12 6
Warm-air foundry	14 2 6
Cold blast	19 5 0
Basic	12 17 6
Scottish—	
Foundry, No. 3	13 10 0
All f.o.t. furnace	
Delivered in Manchester—	
*Derbyshire, No. 3	14 10 0
*Cleveland, No. 3	—
*Scottish, No. 3	15 0 0
* Merchant prices.	
Delivered in Sheffield—	
East Coast hematite	13 5 0
Derbyshire basic	—
Lincolnshire basic	14 10 0
Do. No. 3 foundry	—
Do. forge	—

High-Speed Tool Steel.

	s. d
Finished bars, 14 per cent. Tungsten	3 6
Finished bars, 18 per cent. Tungsten	4 3
Per lb. delivered buyers' works.	
Extras—	
Rounds and squares 3 in. to 8 in. inclusive	4d. per lb.
Rounds and squares under ½ in. to ¼ in.	3d. ,,
Flats under 1 in. by ¾ in. to ¼ in. by ¼ in., and all sizes over four times 3 in width and over thickness	3d. ,,
Bevels of approved sizes and sections	6d. ,,
If in Coils	3d. ,,
Packing	4s. per cwt
Bars cut to length	10% extra
Scrap from High-Speed Tool Steel—	
Scrap pieces, 5d.	
Turnings and Swarf, 3d.	
Per lb. net, d/d steel-makers' works.	

Ferro-Alloys.

Ferro-Titanium—23/25%, Ti. carbonless, 1/6.
Ferro-Tungsten.—75/80%, 2/9.
Ferro-Molybdenum.—70/80%, Mo., 9/–.
Ferro-Vanadium.—35/40%, Va., 45/–.
Metallic-Manganese.—98/99%, carbonless, 3/6.
(All per lb.).
Ferro-Phosphorus—20/25%, P. £50 0 0.
Ferro-Chrome.—4/6%, car., £42 0 0.
Ferro-Chrome.—6/8%, car., £41 0 0.
Ferro-Chrome.—8/10%, car., £40 0 0.
Ferro-Chrome —Specially refined, basis 60% chr., max. 2% car., £91 0 0.
Ferro-Silicon.—45/50% Si., £22 0 0 d/d. at Sheffield Steelworks.
Ferro-Manganese.—80%, £35 loose, £36 packed. Export £38, according to destination.
(All per ton.)

Copper

	£ s. d.	£ s. d.
Standard cash	79 15 0	80 0 0
Three months	80 0 0	85 0 0
Electrolytic	88 10 0	89 10 0
Tough	85 0 0	86 0 0
Best selected	85 0 0	87 0 0
Sheets	139 0 0	—
India	139 0 0	—
American electrolytic spot	87 0 0	89 0 0
Do. Jan	87 0 0	89 0 0
Official average price cash, Oct.		93 10 1½
Do. Three months, Oct.		92 2 1½
Do. Settlement, Oct.		93 7 7½
Do. Electro, Oc.		106 7 1½
Do. B.S., Oct.		102 10 0
Average spot price, copper, Oct.		93 4 4½
Do. Electro, Oct.		107 17 1½

Tin.

	£ s. d	£ s. d.
Cash	221 0 0	221 10 0
Three months	224 10 0	225 0 0
English	216 0 0	217 0 0
Bars	218 0 0	219 0 0
Refined	—	—
Straits	—	221 5 0
Australian		221 5 0
Eastern		212 10 0
Banca		229 10 0
Official average price, cash, Oct.		258 8 8½
Do. Three months, Oct.		263 7 0½
Do. Settlement, Oct.		258 7 7½
Average spot price, Oct.		258 5 11½

Spelter.

	£ s. d	£ s. d.
Ordinary	31 5 0	—
Remelted	30 0 0	—
Hard	24 0 0	—
Electro 99.9	39 0 0	—
English	34 0 0	—
India	30 0 0	—
Zinc dust 92 94%	75 0 0	—
Do. English	—	—
Zinc ashes, per cent. 70%	6 12 6	—
Official average price, Oct.		40 5 6⅔
Average spot price, Oct.		39 15 1½

Lead.

Soft foreign (net)	27 0 0
English	29 0 0
Official average price, Oct.	35 2 1½
Average spot price, Oct.	35 4 9

Antimony.

	£ s. d	£ s. d.
English regulus	45 0 0	48 0 0
Chinese	39 0 0	—
Crude	27 0 0	30 0 0
Ore		Nominal.

Aluminium.

Virgin Metal 98/99— .. .. 165 0 0 per ton.

Phosphor Bronze.

INGOTS.	Per ton.
Alloy No. I. or II.	—
III., IV., or V.	—
IV. or VII	—
VIII.	—
XI.	—
Cast Strips and Ingots	—
CASTINGS.	Per lb.
I. or II.	—
III., IV. or V.	—
IV. or VII.	—
VIII.	—
XI.	—
No. VII., Chill, Cast, Solid	—
,, Cored Bars	—

Delivery 2 Cwt. free to any town.
10 per cent. Phosphor Copper .. £40 above price B.S.
15 per cent. Phosphor Copper .. £50 above price B.S.
Phosphor Tin (5 per cent.) .. .. £30 above price of English Ingots.
Phosphor-bronze prices supplied by CHARLES CLIFFORD AND SON, LIMITED, FAZELEY STREET MILLS, BIRMINGHAM.

*Chromium (Metallic).

98/99— purity, per lb. 7/6

*Nickel.

In cubes, 98/99— purity per ton .. £220 0 0

Nickel Silver.

	per lb.
Ingots for raising	1/7 – 2/–
Ingots for Spoons and Forks	1/7 – 2/–
,, rolled to spoon size	1/10 – 2/3

*Tungsten Metal Powder.

	per lb.
96/98— purity	3/6

*Molybdenum Metal.

96/98— purity, per lb .. .. —

*Cobalt Metal.

97— purity, per lb. 1 0 0

Quicksilver.

75 lb. bottle 15 0 0
* Net, delivered Sheffield Works.

Scrap Iron and Steel.

Cleveland.	s. d	£ s. d.
Steel scrap, heavy melting	—	180 0
Iron scrap cast (cupola metal)	—	210 0
(London f.o.b.).		
Heavy steel		—
Light ,,		—
Heavy cast		—

Steel Scrap.

Without Analysis—	Per ton. £ s. d.
Heavy steel melting scrap	9 5 0
Steel planings, turnings and borings	8 15 0
Steel planings, turnings and borings mixed with wrought-iron or other material	8 10 0
Other classes of steel scrap, whether or not mixed	8 10 0
F.o.r. or in barge at nearest siding or wharf.	
With Analysis—	
Heavy steel melting scrap not over 0.04 per cent. p. and s.	9 10 0
Heavy steel melting scrap not over 0.05 per cent. p. and s.	9 10 0

Wrought-Iron Scrap.

	£ s. d.
(1) (a) W.I. plates and sections, not less than ¾ in. thick, reasonably clear of rivets, flanged ends, etc., suitable for shearing; cable scrap and chain scrap not less than ¼ in. dia.	9 10 0
(b) Heavy W.I. scrap not less than ¼ in. thick including horseshoes, rivets and bolts, and scrap therefrom	9 10 0
(c) W.I. scrap under ¼ in. thick, and all W.I. scrap not included in classes 1, 2 and 3.	9 10 0
(2) Mixed W.I. scrap	8 0 0
(3) Wrought-iron planings, turnings and borings mixed with steel or other materials	6 10 0
(4) W.I. planings, turnings and borings	6 12 6

Cast-Iron Scrap.

	£ s. d.
Heavy ord., broken, between 1¼ cwt. and 10 cwt. each	10 10 0
Heavy machinery, broken between 1¼ cwt. and 10 cwt. each	10 15 0
Cold blast, broken, between 1¼ cwt., and 10 cwt.	12 0 0
Ingot mould, unbroken	11 5 0
Do. broken, between 5 cwt. and 2 tons each	11 10 0
Do. between 1¼ cwt. and 5 cwt. each	11 15 0
Railway chairs, whole or broken for remelting	10 5 0
Heavy lumps, not exceeding 2 tons each	9 17 6
Light	9 10 0
Burnt, broken ready for cupola	8 15 0
Burnt fire bars	9 5 0
Turnings and borings, for iron and steel makers	10 5 0

Old Metal.

London—	£ s. d.
Copper (clean)	66 0 0
Brass (clean)	42 0 0
Lead (less usual draft)	25 10 0
Tea lead	23 10 0
Zinc	18 0 0
New aluminium cuttings	120 0 0
Brazlery copper	56 0 0
Gunmetal	58 0 0
Hollow pewter	140 0 0
Shaped black pewter	80 0 0
(Above all d.d merchant's yard).	

Metallurgical Coke.

Durham and Northumberland—	£ s. d.
Blast furnace	3 2 9
Foundry	3 10 0
Lancs., Staffs., Yorks, Notts., Derbyshire, Lincolnshire and Midland Counties—	
Blast furnace	3 5 9
Foundry	3 17 9
F.o.t. at ovens.	

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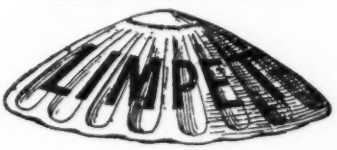

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SITUATIONS VACANT AND WANTED.

WANTED Position as Foundry Manager; Midlands or South of England preferred. At present serving contract in India under 2 years' agreement; contract concluded on October 31, 1920. Iron or Steel Castings up to 100 ton in weight, in Engineering or Shipbuilding. Possesses a wide experience in the largest firms in the United Kingdom. Also a great knowledge of Brass, Copper, and Aluminium; Castings; Mixtures of Sands and Paint, etc.; Moulding Machines.—Apply, Box 570, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, Adelphi, Strand, London, W.C.2.

ADVERTISER, with sound, practical knowledge of Pattern and Stripping Plate Moulding, for different types of moulding machines, including the Bonvillian and Ronceray. Present position 18 months; desires a change.—Reply to Box 612, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, Adelphi, Strand, London, W.C.2.

FOUNDRY MANAGER wanted, accustomed textile work; machine and floor, also jobbing.—State experience fully, also salary expected, Box No. 592, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, Adelphi, Strand, London, W.C.2.

FOUNDRY FOREMAN, age 35, with 8 years' experience as a foreman moulder, desires a change. Fully experienced in machine moulding, foundry production, and costings of castings. Could take entire charge of foundry.—Apply Box 606, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, Adelphi, Strand, London, W.C.2.

FOUNDRY FOREMAN, practical iron moulder, hand or machine, seeks change for New Year; a good all-round practical foundryman; no objections to small country shop.—Write, Box 610, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, Adelphi, Strand, London, W.C.2

THE Advertisers require a FOREMAN, to take charge of their Brass Foundry (floor, bench and machine work). Output 10-15 tons per week. Only men who have held a similar position and are capable of increasing production need apply to Box No. 614, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, Adelphi, Strand, London, W.C.2.

FOUNDRY FOREMAN WANTED, thoroughly experienced in cupola practice, and mixing to analysis, and able to produce clean, sound, machinable castings, free from cinder and blow holes. Reply, stating methods would adopt, experience, age, and salary expected.—Box 604, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, Adelphi, Strand, London, W.C.2.

WANTED.—Midlands Foundry, Competent Foreman; cast-iron medium castings and other metals; 20 hands; permanent job; £5 10s. per week good man. State age and experience.—Box 600, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, Adelphi, Strand, London, W.C.2.

FOREMAN for Malleable Iron Foundry required. Must thoroughly understand quality and quantity production on repetition work, moulding, mixing of metals, melting and annealing. Permanency and bonus on output to competent man.—Apply, giving full particulars of experience and wages required, to MARTIN'S CULTIVATOR COMPANY, LIMITED, Agricultural Engineers, Stamford, Lincs.

MOULDER, thoroughly practical all round, desires permanency; firms expecting houses for workmen correspond; housing accommodation sole reason for leaving.—Box 590, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, Adelphi, Strand, London, W.C.2.

SITUATIONS VACANT AND WANTED.—*Cont.*

MOULDER, leading hand wanted, accustomed repetition work similar textile castings; state age, references, wages.—Address, "OMEGA," WM. PORTEOUS & COMPANY, Advertising Agents, Glasgow.

EXPERIENCED TRAVELLER wanted for a London Iron Foundry. Must have had previous experience in the trade, and be capable of estimating and quoting prices.—Write, stating qualifications and salary required, to Box 598, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, Adelphi, Strand, London, W.C.2.

AGENCIES.

WELL-KNOWN METALLURGIST, with considerable works experience, is open to consider a few sound Agencies. Good offices and warehouse. Correspondence invited.—Write E.36, "Sheffield Daily Telegraph," Sheffield.

GENTLEMAN, well-known, calling on foundries in Yorkshire, desires Agency for sale of pig-iron, commission basis; bank references.—Box 608, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, Adelphi, Strand, London, W.C.2.

A PATTERN MAKER and a Brass Moulder, about to commence a small Brass Foundry, would be pleased to invite inquiries from those that require good sound Castings, with prompt delivery. Repetition work a speciality.—Apply Box 616, Offices of the FOUNDRY TRADES JOURNAL, Bessemer House, Adelphi, Strand, London, W.C.2.

FOR SALE AND WANTED.

TURN TO THE B.W.S. ANNOUNCEMENT, PAGE 912.

CASTINGS, machine or hand moulded. Orders wanted for any weight or quantities with or without customers' patterns (machined if necessary); large modern plant.—Engineering Department, ROBERT HEATH & LOW MOOR, LIMITED, Low Moor Iron Works, Bradford, Yorks.

6-FT. DIAMETER PAN FOUNDRY SAND MILL, also Tilghman's Sand Blast Barrel, for immediate sale.—Box 596, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, Adelphi, Strand, London, W.C.2.

FOR SALE, Geared Foundry Ladle, capacity 50-60 cwt., first-class condition.—Box 594, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, Adelphi, Strand, London, W.C.2.

FOR SALE, Foundry Ladle, geared, and in good condition, 34 in. diameter, 24 in. deep.—To be seen at Foundry, Twickenham Road, Teddington.

FOR SALE, Horizonal Rotary Sand Mixer, by Hall & Company, consisting of two sets rotary cages, running in opposite directions, capacity about 5 cwt. per minute; in splendid order. Price £37 10s., f.o.r.—Apply LAKE & ELLIOT, LIMITED, Braintree, Essex.

FOR SALE, "Duplex" Centrifugal Vertical Foundry Sand Mixer, by Britannia Foundry Company, height 3 ft. 10 in., hopper 2 ft. diameter, capacity 3½ cwt. per minute; excellent working condition. Price £50, f.o.r.—Apply, LAKE & ELLIOT, LIMITED, Braintree.

FOR SALE.—800 tons high-class Broken Machinery C.I. Scrap at 10 guineas per ton, f.o.r. Croydon District.—Sample can be seen at STANDARD STEEL COMPANY, LIMITED, Waddon Marsh Lane, Croydon.

FOR SALE.—Two Brookhouse Pneumatic Moulding Machines; perfect condition.—PICKLES, Ironfounders, Mytholmroyd.

FOR SALE AND WANTED.—*Continued.*

PIG-IRON (SWEDISH).—What offers? We have 2,000 tons for delivery from November to February; analysis as follows: Si., 0.75 per cent; Mn., 3¼-4 per cent.; P., 0.030 per cent.; S., 0.025 per cent.—MACHINERY & STEELS, LIMITED, 64, Great Eastern Street, E.C.2.

WANTED, turnover Jolt Ramming Moulding Machine, to take boxes about 3 ft. sq. Also small size rapid Milling Cupola.—Particulars to John White, Westfield Foundry, Gorgie, Edinburgh.

THE GALLOWAY ENGINEERING COMPANY, LIMITED, are buyers of the following materials for motor car manufacture, and they invite offers for same. Terms, spot cash. Castings in Aluminium, Iron and Gunmetal, Metals; Aluminium, Gunmetal and anti-friction Metals.—Address offers to, Buying Dept., Heathhall, Dumfries.

ONE 18-in. Invincible Sand-Mixer, capable of mixing, screening and preparing 1 ton per hour old and new foundry sand.—Apply Box 618, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, Adelphi, Strand, London, W.C.2.

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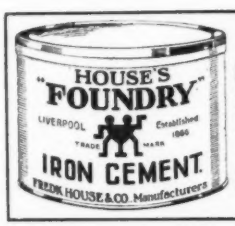

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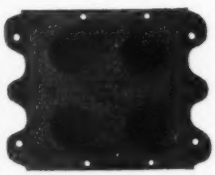

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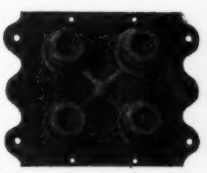

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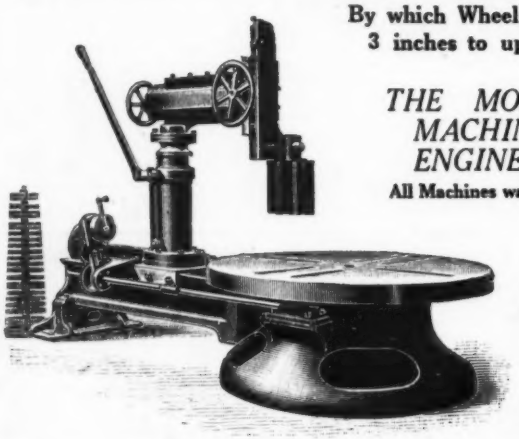

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